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## CHEMISTRY AND THE AMERICAN CHEMICAL SOCIETY[1]

IN sorting over some old papers recently I came across one to which I should like to make brief reference. If not to point a moral, it may at least furnish the starting point for a tale.

With due apologies for any personal factors involved, the paper in question was in the form of a certificate or receipt, and conveyed the information that the bearer had satisfied the formal requirements and had paid the matriculation and other fees for entrance as a freshman at a midwestern university. The date of the certification was September 18, 1878, and the name certified thereto was my own.

I should like for a moment to assume the rôle of a historian, for reasons that I trust will be evident a little later. I would not have it inferred that my chemical consciousness suddenly and decidedly sprang into full being on that date, or that I have experienced an even fifty years of chemical joys and sorrows. As a matter of fact, I would like to go back more than fifty years and make a very brief survey of science in general in this country. Several reasons may be assigned. There was at that time hardly enough of any one specific science to occupy all of any one's attention. There seemed to be time for consideration of the field of science as a whole. It was not unusual to have a professor of general science who taught everything from astronomy to chemistry, including between those limits such subjects as botany, zoology, geology, physiology and physics, or natural philosophy as it was more commonly called. It is not strange, therefore, that any one leaning a little away from the classics fifty years ago should lean toward science in general rather than to any specific field under that heading. In my own case there were additional reasons for interest along general lines. One of my most beloved instructors was an ardent admirer and disciple of Agassiz, with an infectious zeal born of direct association with him on the Isle of Penikese. Another instructor was at the time, and still holds active leadership as, the greatest authority in this country on birds and fishes. Another was direct from the laboratory of the great Liebig, and was just assuming charge of a department already well organ-

[1] Presidential address delivered at the 76th meeting of the American Chemical Society, Swampscott, Mass., September 16 to 19, 1928.

ized and for some years under the direction of an enthusiastic disciple of Josiah Parsons Cooke, of Harvard.

### General Science Half a Century Ago

As already indicated we seemed to have more time in those days. And so it is not illogical if I say a few words about science in general of fifty and more years ago.

Out of the circumstances thus alluded to there is suggested the obvious fact that there was more time for wider interests because none of the fields of science had as yet entered upon that intensive investigational and developmental enlargement which has characterized each one of them in more recent years. And this is a main point which I wish to briefly emphasize.

I have said that there was more time for wider excursions in the general field of science and that this was because the detailed information in any field was relatively meager and not beyond the possibility of a reasonable degree of acquaintance by any one interested in several fields at once. This is simply saying in another way that research and the greatly multiplied and widely distributed investigator had not yet come into existence, though, as a matter of fact, the skyline of the scientific horizon was beginning to take on new and decided characteristics.

Let me set forth a bit of evidence by way of confirmation of this statement. I think it will be agreed that the published material in any field is a correct index of the activity in that field. If the demand for publication space is active, then publication space to meet the demand will develop. Conversely, if there is little demand for publication space, there will be but little publication in evidence. Let us develop this publication weather vane for a moment.

What were the channels of scientific publication fifty years ago? That is a good date from which to view the situation, for in a general way it constitutes a sort of dividing line between the old order and the new.

Previous to the year 1878, one could count the total number of journals published in the general field of science in this country on the fingers of one hand and still have fingers to spare. It will be of interest to name them: *The American Journal of Science and Arts, The Journal of the Franklin Institute* and *The American Naturalist.* We might extend the list to take up the remaining fingers by including the *Journal of the Academy of Natural Science of Philadelphia* and possibly the *Cincinnati Quarterly Journal of Science,* but it does not exaggerate the point I wish to make to limit the count to the first three named, which is, that the investigational activity in the entire field of science fifty years ago was in an elementary or at least in a beginning stage. Even if we were to include a list of such special or annual publications of proceedings of societies, transactions, bulletins and reports of bureaus, we could only augment the count for that period by about twenty.

Allow me to give some further specific illustrations. If we take as an index of a slight advance in the more intensive study of fuels the ultimate analyses of the coals of the country, which had been made up to the year 1878, they would number just about forty all told. What publication medium was open to them? Six of these results were published in the year-book of the board of trustees of the university where the work was carried on, four were included in a bulletin detailing a power test conducted by the engineering department of another university, and thirty were embodied in a report to the United States Government in 1844. This last was a most elaborate and scientific treatise of 600 pages. Ten thousand copies were ordered printed and it was listed as Senate Document No. 386. Outside of ten or twelve of the older and larger libraries of the country I think one would be reasonably safe in offering a substantial prize for the discovery of the existence of copies of this very interesting and valuable report.

Here is another illustration. The very momentous discovery of the bacterial character of certain plant diseases was made in this country during the years 1876 to 1878. Where did it find an outlet for publication? It was first reported in a paper read before a state horticultural society and published in its annual report for 1878. This was followed by a further article printed in the 1880 proceedings of the American Association for the Advancement of Science.

Here is another illustration of quite a different sort, but corroborative of the general proposition that scientific columns were not over numerous, and such as existed were not overcrowded. In the *American Journal of Science and Arts* certain articles occurred in 1819 and in 1824, from which quotations may be of interest. The title is: "A Notice of Col. John Trumbull's Picture of the Declaration of Independence." I quote:

> The painting represents the congress at the moment when the committee advanced to the table of the president to make their report. It contains faithful portraits of all those members who were living when the picture was begun and of all others of whom any authentic representation could be obtained. Of a small number no trace could be discovered and nothing was admitted which was not authentic . . . Col. Trumbull, himself an actor in the great scenes which terminated in the establishment of American Independence, very early conceived the design of preserving the portraits of some of the most distin-

guished men of that period and of transmitting them to posterity in situations in which they were real actors. It is believed that in this picture the United States possesses a treasure to which there is no parallel in the world. In no instance within our knowledge is there an exhibition to an equal extent of the actual portraits of an illustrious assembly concerned in so momentous a transaction.

The president of the congress was John Hancock, and the committee consisted of Jefferson, Adams, Sherman, Livingston and Franklin. Possibly the last name carries with it a scientific flavor sufficient to admit the article to the *Journal of Science* at that time. I repeat again that scientific publication channels, though meager, were fully equal to the demand for space.

But beginning with the time substantially fifty years ago, a remarkable increase in both the number and value of scientific publications is evident. During these years and following, there must have been a phenomenal growth in investigational activities if the multiplication of periodicals can be taken as a criterion. If we foot up the number of scientific periodicals published in this country at the present time, beginning with bacteriology and botany and running through the list to X-rays, the total count, not including trade journals, has advanced from the three or possibly five journals of 1878 to 288 at the present time. If to this we were to add the bulletins that appear from experiment stations, government bureaus and the annual transactions and supplemental publications of scientific societies, it could hardly be an exaggeration to say that this number represents only about one half of the total annual output for the presentation of investigational work for the country as a whole. The real significance of these figures can scarcely be realized.

It is obvious, therefore, that somewhere along about fifty years ago we might very properly draw a dividing line between the old order and the new. It was the starting point of a new period when the investigational type of procedure in all scientific lines was taking on new life and unprecedented activity. While it would be not without interest to continue our general survey down through the more recent years, it would not serve the immediate purpose in hand. These brief historical references, which may seem irrelevant and somewhat divergent from the realm of chemistry, are amply justified, I believe, in so far as they furnish a sort of background from which we can set over in more striking outline the developments in our own field of chemistry.

### THE NEW ORDER IN CHEMISTRY

In this new era, therefore, of investigational activity in all scientific lines, it is entirely logical to assume in the very nature of the case that chemistry would be having its share. Let us, therefore, on this general assumption as to the significance of publications take the simple matter of publication space as an index of development in the chemical field. Prior to 1878 there was substantially no medium in this country devoted to the publication of the results of study in the chemical field.

Here again the development of periodicals in this country furnishes an interesting sidelight on the halting progress of chemical development. There was much stuttering before we really found our organs of speech. First, there was the old *Boston Journal of Chemistry,* founded some twelve years previous to the line of demarcation of 1878 which we have somewhat arbitrarily set up. But that journal was rather general in character, announcing that it was devoted to chemistry as applied to medicine, agriculture and the arts, and hardly attained the rank of a chemical journal, leaning more to popular topics than to chemistry. Then came along the idea of reproducing English journals in this country, and from 1867 to 1870 the *London Chemical News* was thus reproduced. This was not satisfactory and was replaced by the *American Chemist,* with C. F. Chandler as editor. In 1884 the same attempt was made with the *London Analyst,* but after a year it also gave up the chemical ghost and became the *New York Analyst* and then the *American Analyst* under the leadership of Henry Lassing. It so continued until 1894 when it became the *Popular Science News of Boston.*

With the organization of the American Chemical Society in April, 1876, a new publication was started, designated as the *Journal of the American Chemical Society,* but for several years it was a very crude mixture of proceedings and papers, the latter consisting of discussions presented at the stated meetings of the so-called society. The first volume was published in 1879. The minutes of the society up to that time had been printed in the news columns of the *American Chemist.*

In April, 1876, there had also been created the chemical section of the New York Academy of Sciences, which was the revamped and renamed New York Lyceum of Natural History, already sixty years old, but then enlarged to include chemistry and physics. The newly organized American Chemical Society, also born in April, 1876, was in fact and in membership nothing more than the chemical section of the New York Academy.

In 1879 Dr. Remsen, presumably not liking the provincial nature of the new venture, started a journal of his own and called it *The American Chemical Journal.*

Probably nothing is more illustrative of the trend at that period than the sporadic attempts to occupy this field of the physical sciences, stimulated no doubt by the activities connected with the World's Fair of 1893, blasted also no doubt by the financial collapse following that event. This is shown in a very graphical manner by the successions and survivals. For example, the old *Boston Journal of Chemistry* became the *Popular Science News,* and this in 1899 became *Popular Science,* under which title it had acquired by absorption or as legatee and otherwise: *The Field and School Naturalist, Health and Home, Health Helper, American Analyst, Minerals, Young Scientist, Industrial Monthly, Technologist, Geographical Magazine, Home Arts, Archaeologist, Youth's Journal, Health Monthly, Natural Science News, Technical Journal, Hall's Journal of Health, Nidologist, The Observer,* and *Natural Science Journal.*

But in the course of time order came out of chaos. The *Journal of the American Chemical Society,* whose first volume was printed in 1879, had attained a size, in the combined volume of proceedings and paper for the year 1884, of 300 pages and a magnitude otherwise indicated by saying that it was just one inch thick.

Some other illuminating items in that volume, No. 6, are worth noting. In the proceedings for February 1, 1884, we read, "As only twelve members were present there was no quorum and eight nominations for membership could not be acted upon," whereupon it was "suggested that Article 8 of the Constitution be amended that the quorum be reduced from 15 to 10 members." The report of the treasurer showed an expenditure for 1883 of $882.21 and the cost of printing the journal was $373.20. And this was the American Chemical Society just forty-four years ago.

But following our publication theme, it may be noted that the peak point of the journal of one inch thick in 1884 reached its minimum dimension in 1889 of a bare one half inch in thickness. From that date an upward trend occurred, possibly due to the rivalry attendant upon the starting of the *Journal of Analytical Chemistry* by Dr. Hart in 1887. This publication, under the title of the *Journal of Analytical and Applied Chemistry* from 1890 to 1893, was merged in the latter year with the *Journal of the American Chemical Society.* By this time the society membership had reached the number of 423. The journal printing bill for the year 1892 was a trifle over $1,000. The secretary received no salary, and the society after fifteen years of quiescence had broken its New York bonds and was actively seeking a status both east and west of the Hudson.

In the intervening thirty-five years, from a membership of a little more than 400, the society has grown to considerably more than 16,000, and from an expense budget of about $2,000 to a sum amounting to approximately $350,000 annually. Moreover, the publications of the society, five in number, are believed to be in their respective fields unsurpassed in any country anywhere in the world to-day.

Now if my line of argument is valid, and I believe it is, this means that investigation and research in this country in chemical science and its technical application command a leading place. Indeed, I doubt if we begin to comprehend the magnitude of the development that has taken place in chemical discovery and achievement and adaptation even in the last ten or fifteen years. It affects every phase of our daily living, in matters of sanitation, of health, of food requirement, of remedial agents, in matters of clothing and art and comfort of living, in transportation and conservation. The chemist and chemical science are now and are coming to be recognized as dominating factors in the promotion of human welfare.

The output of chemical products alone in this country has advanced from an insignificant sum fifty years ago to over $2,000,000,000 annually at the present time. It would be impossible to estimate in addition the enhanced value of other industrial products, the economies effected, the waste utilized, the new things done, and the old things done in a better way as a result of chemical guidance and supervision.

## RÔLE OF THE AMERICAN CHEMICAL SOCIETY

And now what is the significance of it all?

(1) There are some factors, traditional and otherwise, which have had, I believe, not a little to do with the success of the American Chemical Society. When it broke over the boundary line of Manhattan and formulated a new constitution in 1891, and in fact became a new society, it emphasized a feature in the new order the value of which few could fully realize at the time. It should not be lost sight of, and from time to time needs restatement. To offset the exclusiveness that had for fifteen years characterized the society, the plan was adopted of establishing sections throughout the country to the end that the membership everywhere might know that they were in truth a part of a great society and had an actual voice in its direction and management. It is the old story of the democratic form of government, the secret and the success of which hinge upon the intelligent use of the powers delegated to the membership as a whole.

I think in this new method the society has very noticeably been free from the domination of the larger sections and has very happily escaped the pitfalls of bureaucracy, a disease that so frequently threatens the health of large organizations. But the same health

needs safeguarding. I believe one of the most potent influences is the simple one of acquaintanceship. In the earlier days there was a tradition that the leaders in the society were peculiarly gifted in their desire to form the acquaintance of the younger, oncoming members. Any young chemist especially who has had the whole-hearted greeting as that of an old friend by such men as Chandler, McMurtrie, John H. Long and the beloved Edgar F. Smith has not only received a feeling of cordiality and genuine friendship, but gained a sense also of a place and real partnership in the affairs of the society. Those who knew Will (Bill) Brady will appreciate the remark he made on one occasion to the effect that he attended the meeting of the American Chemical Society for the good he got out of the corridor sessions. There is real logic and value in this general idea. As we grow larger and more specialized along particular lines it may require new methods of expression. I believe there is great value in those smaller assemblies where the individual is not lost in the crowd, such as regional meetings, symposia, reunions by institutions of fraternal organizations, group dinners and the like. I believe even the visits of the president to the sections, for this reason of acquaintanceship if for no other, have their value and should be made possible of extension.

(2) The phenomenal development in chemical research in the past twenty-five or thirty years has accompanied a phenomenal growth and expansion on the part of the American Chemical Society. This is not a mere coincidence. I believe it can be shown that the greatest single factor in the development of chemistry in this country has been the society. One need only consider the influence naturally resulting from its publications, its general meetings with their crowded programs, sectional and regional meetings, symposia and institutes, to be made readily aware of the tremendous influence emanating from the organization as a whole.

(3) There is no other field of research which has to the same degree the potential contribution to human welfare as the field of chemistry. This needs no elaboration to a group of chemists. This is a chemical age and we live and move and have our physical and physiological being as a result of chemical processes. Whether we travel on foot in chrome-tanned shoes and rayon stockings or roll to work on rubber wheels and concrete roads we travel in comfort by chemical grace and good-will. If we land in the hospital, the chemist has anticipated our coming and is there before us with antiseptics and anesthetics and remedial agents for the relief of suffering and the restoration of health. Indeed, there is no phase of our modern life in which the chemist does not contribute in some form or other directly and substantially to our comfort and happiness.

We admire the work of the engineer—a great bridge, an imposing structure, an impressive skyline—but the skyline of the chemist is to be seen in the advancing status of human welfare, and from the towers and heights of his fabrication shine ever the rays of helpfulness and good-will.

(4) The funds now set aside in this country for scientific research are unprecedented in amount and run into the hundreds of millions of dollars. An analysis of the gifts and the purposes specified for their use affords a striking illustration of the fact that men of great wealth give most freely of their substance to projects that have for their ultimate purpose the bettering of the conditions of human living. The real story of chemistry is just beginning to be told. The real facts of chemical research are just beginning to appear. If the results of the last twenty-five years are impressive and even startling, there can be no other conclusion than that in the very nature of the case the accomplishments of the next twenty-five years will be even more striking and even more profoundly important in their influence over the welfare of men.

Should we not consider the propriety, indeed the desirability, of adding a board of trust or assigning to some well-established trust organization the duty of receiving and safeguarding the contributions and bequests that are certain to fall to the lot of the society? That simple fact would advertise the security of such funds, and in itself invite its use as a repository for funds to be spent along chemical lines. The accruing values would be turned over to the governing board of the society, who would be better able to judge of the most suitable channels or objectives for the wise expenditure of the available funds and best qualified to carry out the wish of the donors. This general plan is already well illustrated by the mechanism just now operative for the handling of the Frasch bequest of $1,000,000, the annual income from which just now becoming available is announced by the trust company named as legatee to be $40,000.

## FUTURE OBLIGATIONS OF THE SOCIETY

In brief, does the American Chemical Society catch the significance of the passing days? Is it ready for the larger responsibilities that are certain to fall? Has it a conception of its duty and obligation to itself, to its membership, to the cause of chemistry and its mission, sufficiently comprehensive to move forward in the rôle of leader and guide?

It is not sufficient to be satisfied with commendations for past accomplishments. It is, of course,

heartening that we have come so well up to the duties and opportunities of the years that are behind us. They carry the best promise of competence in solving the problems of the future. My plea is for alertness and that our wisdom be limbered up and burnished a bit so as to be ready beforehand instead of a year or two too late.

This is not the time nor do I wish to assume the rôle of monitor concerning the future policy of the society, but I conceive it to be timely that the problem at least be stated, and with it affirm my supreme confidence in the wisdom and ability of the society to meet its enlarging opportunities and maintain its rank both in leadership and service in the almost inconceivably great and comprehensive cause of chemical accomplishment in the years immediately before us.

S. W. PARR

UNIVERSITY OF ILLINOIS

## FRANCIS WELD PEABODY

FRANCIS WELD PEABODY was born in Cambridge, Massachusetts, on the twenty-fourth of November, 1881. Through many generations his family had been prominent in New England and included among its members distinguished and able citizens. His father, long associated with Harvard University, was at one time dean of the Harvard Divinity School. Peabody's early life was spent in Cambridge and in Boston and thus, not only through inheritance, but through environment, he was deeply imbued with many of the finest attributes of the New England character.

As a boy he lived in an atmosphere of culture and in early youth came intimately in contact with older men of intellectual achievement or of brilliancy of mind. He was frequently at the house of William James, where he became a close friend of the family, and it is interesting that the last year of his life was spent in that quiet old house with its spacious library and charming garden where, years before, William James had lived and worked.

Peabody entered Harvard College in 1899 and graduated with honors in 1903. That autumn he entered the Harvard Medical School. Here he proved to be a student of distinction and before the four years of study were completed, he had become interested in research and had found time during the busy days to devote himself to a bacteriological problem relating to typhoid fever. In 1907 he received the degree of doctor of medicine, conferred again with honors, by the Harvard Medical School. The following year, which was spent as interne in the Massachusetts General Hospital, completed the first period of his medical training, and laid the foundation for the future work which he was to carry out with such distinction.

He must now have had a desire to widen his experience in medicine and to enlarge his knowledge of the ways of men and their methods of work. Such an opportunity arose when an offer came to fill the position of assistant resident physician under Dr. Thayer at the Johns Hopkins Hospital. This he accepted and during the following year he devoted his time to the clinic in Baltimore. It was not long before he had endeared himself to all his associates, and was soon regarded with respect by both the junior and senior members of the staff. His unusual ability, his quiet perseverance and his gentle humor attracted many men, who recall now with pride and affection the happy days spent in his company.

At that time Dr. Welch was active in the pathological laboratory and there could be nothing more natural than that Peabody should wish to have a year in the study of pathology, particularly since it could be spent under the direction of Dr. Welch. During the year 1909–10, therefore, he served as fellow in pathology and came in frequent contact with one of the great men in American medicine.

These two years of varied activity were followed by a third year of preparation and study abroad, where now he went to receive training in organic chemistry. Again he chose to work under two eminent masters, Emil Fischer and Fresinius. One can not doubt for an instant the reason for this selection. With unfailing judgment and acute perception he could always recognize the superior qualities of mind in men. He sought invariably the master, and was accepted as the unusual pupil. In the many delightful relationships which he made in this manner there always seemed to be a mutual recognition of ability and an indefinable sense of attraction between the two men.

There was still another reason, however, why Peabody should wish to spend these years in an apprenticeship in medicine. It was becoming apparent that methods hitherto inapplicable to the study of disease in man were rapidly being adapted to this purpose. By chemical procedures, in particular, one could gain new information. Possibly he had some clinical problem in mind which he thought might be solved through chemical investigation. Certainly if this were true he desired to learn the best methods, to come in contact with the best minds, so that he might render the best service to his problem. One sees him actuated by this motive again and again. No effort is spared to elevate the work to a superior level. But as he himself has said, it is always the problem that must come first, the ardent desire to answer a difficult question propounded in the clinic. When unfamiliar methods are required for the solution of this problem, these must be learned under expert tutelage. Peabody has referred to this as the intellectual rather than the technical approach

to clinical research, and it is the method which he himself invariably employed.

Following the year abroad, there came an opportunity to assist in developing, under unusually favorable circumstances, ideas and methods which were comparatively new to clinical medicine in this country. The Hospital of the Rockefeller Institute had recently been opened under the direction of Dr. Rufus Cole for the study of disease in man, and in the perfectly equipped wards and laboratories of this hospital it would be possible to investigate human disease as a problem in itself. Peabody was appointed an assistant resident physician, and thus formed one of a small group of men who soon became absorbed in a series of intensive clinical studies. He first devoted himself to some investigations upon poliomyelitis, and wrote upon the subject, but later his attention was turned to certain chemical problems in relation to lobar pneumonia, a disease which was being subjected to investigation at the hospital from many points of view.

It is highly probable that the perplexing problems of dyspnoea and cyanosis in pneumonia awakened his interest in the physiology and pathology of the respiration, for after leaving the Rockefeller Hospital he again went abroad, this time partly to visit European clinics and partly to work in physiology. He chose, at all events, for his physiological studies the laboratory of Professor Krogh, in Copenhagen, a man who is recognized to-day as one of the pioneers in the modern study of respiratory functions in man, and who moreover has contributed work of fundamental importance in the capillary circulation. Peabody was one of the first, if not the first, American student to work in these laboratories.

After several months abroad he returned to Boston to help organize and develop a new and modern medical clinic under the direction of Dr. Henry A. Christian at the Peter Bent Brigham Hospital. He entered upon the duties of resident physician, a position which he held from 1913 to 1915. This new clinic was equipped with excellent laboratories and Peabody soon started a series of important clinical investigations upon the respiration. The problem was continued and developed over many years though interrupted at times by urgent calls to other duties, but through these studies which are now widely known, he contributed knowledge of both fundamental and of practical importance.

These investigations, however, important as they were, formed only a part of his active and useful life at the hospital. He was constantly in the wards, indefatigable in the care of his patients, gaining experience in clinical medicine, working with students, developing the teaching in clinical microscopy and training and stimulating the younger assistants who came to work with him. It was not long before the remarkable example which he set produced an influence far beyond his immediate field of activity. His sound judgment, his wide knowledge and his clear conception of the lines along which clinical medicine should be developed, all led to his being sought in consultation from time to time on matters pertaining to medical education.

Among other requests he was asked in 1914 by the Rockefeller Foundation to join a commission which was being sent to China to confer on the desirability of creating a new medical school in Peking. The counsel which he gave on this occasion was of much value to the commission, and undoubtedly he exerted considerable influence in directing the policies which were to be carried out in this new school of medicine. An appreciation of the service which he rendered was evidenced by the fact that he was made a member of the China Medical Board of the Rockefeller Foundation. His interest in the establishment and growth of the Peking Union Medical College continued, and later he was invited to act as visiting professor to the medical department. The winter of 1921 and 1922 was spent in this position in China.

In 1916 Peabody was appointed assistant professor of medicine at the Harvard Medical School and physician to the Peter Bent Brigham Hospital. With the acceptance of this position he relinquished his post as resident physician and became one of the visiting physicians to the hospital. At the same time he was appointed consulting physician to the Collis P. Huntington Memorial Hospital. The work which had engaged his attention as resident physician was now continued and somewhat expanded. Constant visits to the wards of the hospital, teaching and the development of his important clinical investigations upon the physiology and pathology of respiration occupied his time and attention. In all likelihood, too, it was at about this time that his interest was awakened in diseases of the blood. The course in clinical microscopy, which he had conducted, gave him familiarity with the accepted knowledge of this subject, and the new appointment as consulting physician to the Huntington Hospital placed a new responsibility upon him, for one of the important problems which had been developed in this institution was the investigation and treatment of diseases of the blood. Though spare moments must have been given to theoretic consideration of this subject, his principal interest, as far as investigation was concerned, was not diverted from the study of the respiration, which he pursued thoughtfully and systematically for several years until his problem was brought to a logical conclusion.

All this work was interrupted abruptly, however, by our entrance into the war. Early in 1917 he was sent to Roumania and later to Russia as a member of the American Red Cross Commission, and on his return to this country entered the Army Medical Corps. Among other duties he was detailed to the Army Hospital at Lakewood, New Jersey, where there were under his care many soldiers suffering from the condition known as "irritable heart" or "effort syndrome." He immediately availed himself of the opportunity to study several perplexing questions in regard to this condition, which was a relatively common and important cause of invalidism in the army, and through his observations added information that was of considerable practical value. Later he was ordered to France where he served as consultant.

On his return he resumed his duties in Boston, and though he saw patients in consultation and was indeed sought after for his expert knowledge, his unusual clinical ability and his human understanding, still his keen sense of responsibility towards the clinic, his devotion to his students and assistants and his desire to advance our knowledge of disease in man occupied practically all his days.

By this time, in spite of his innate modesty, he had attained a position of great importance in the medical profession. His advice was sought on many matters of importance. He was offered the chair of medicine in several of the leading medical schools of this country, and though he felt that his duty lay in Boston and that he must refuse these calls, yet in doing so he never failed to aid these institutions in their efforts to organize the medical clinics along the most productive and idealistic lines.

Finally there came to him a request which he could not refuse. The Boston City Hospital was about to establish in connection with the general hospital a department of research in a new building to be known as the Thorndike Memorial, which was to contain laboratories for investigation and small wards for the study of selected groups of patients. Peabody was asked to become director of the Thorndike Memorial and to take charge of one of the medical services of the Boston City Hospital. The problem which was presented to him was a new one, and he immediately conceived of it as having important bearing upon the progress of medical education and clinical research in America. In 1922 he accepted the offer and was made professor of medicine at Harvard University.

The remaining years of his life were devoted to the organization and development of this clinic. In doing so he laid great emphasis upon the fact that the Thorndike Memorial, a research department, was founded as an integral part of a great city hospital, by which it was supported. It was a significant fact that the trustees of a municipal hospital or indeed of any hospital should consider that they had not fulfilled their responsibilities by limiting the service of the hospital to the treatment of patients alone, but felt obligated to extend the field of activity to medical teaching, preventive medicine and medical research. The idea was of far-reaching importance and the plan must be developed with great thought and care in order that it might grow to fruition. Peabody had a perfectly clear conception of what he wanted to accomplish, and it required only time and patience to work out the details for the organization of this research department, where very shortly he gathered together a productive group of enthusiastic and devoted young assistants. His ideas concerning the development of this great clinic were clearly defined, his vision broad and far reaching. Fortunately he has recorded some of these ideas with characteristic simplicity and beauty of expression, in a letter which has recently been published.

The increased responsibilities that came to him with the directorship of the Thorndike Memorial in no way diverted him from his search for knowledge about disease processes, though it required increasing effort to find time for investigation. With his usual quiet and intelligent persistence he commenced a series of studies on pernicious anaemia. To this subject he made significant contributions before the progress of these researches was cut short by his death. One of the last honors that came to him was his appointment to the Board of Scientific Directors of the Rockefeller Institute for Medical Research in 1926.

The simple record of a man's life reflects in some degree his qualities and his character, but the value of his work and the extent of his influence are indissolubly linked with something more intangible, something less easily defined and measured than the sum of his achievements, great as these may be. The lasting quality of any work, the survival of a personality must depend upon the vision and nobleness of the character of the man himself. It was the rare nature of Francis Peabody that gave his life's work a peculiar significance, that was appreciated even more deeply by the members of his profession and by his friends than by those who could not come so closely in contact with him. Love of truth, sincerity of purpose and human understanding were among the guiding principles of his very existence.

The value of his clinical investigations rests upon the sincerity and patience with which he sought the truth, the accuracy of his observations and the logical development of his problems, but this represents only a part of his contributions to medicine in this country. As a physician and an inspiring teacher of students and assistants his influence was quite as remarkable.

He had learned to know his fellow men, to look with sympathy upon their misfortunes and to use his knowledge wisely for their benefit. He was essentially the good physician absorbed in the patient and in unraveling the intricate meshwork of difficulties that surrounded him, whether these were maladies of the flesh or of the mind. No better impression of his attitude towards the sick can be gained than from his own essay on "The Care of the Patient," where the theme is developed with unusual insight and understanding.

Above all perhaps he inspired perfect faith and confidence in his students, his assistants and his friends, and finally during his last illness, his fortitude and great spiritual qualities bore all before them and uplifted unforgetably those who came in contact with him far above the tribulation of earthly things.

Francis Peabody died in Cambridge on October 13, 1927. His loss is a great one to American medicine. The record of his life, his work and his character remain as an inspiration to all who enter the field of medicine, while his noble fortitude and gallantry persist as a precious memory for his friends.

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## SCIENTIFIC EVENTS

### CZECHOSLOVAKIAN EXPOSITION

IT is reported in *Nature* that, in celebration of the tenth year of the existence of Czechoslovakia, an exhibition of contemporary culture and scientific achievement has been arranged at Brno, in Moravia, and will remain open until the end of October. The exhibition is designed to show the progress made during the country's brief existence. The scientific and general studies conducted in different types of schools, institutes and colleges are portrayed, culminating in the research exhibits from the science faculties of the universities and from special research associations. The great increase in the number and circulation of cultural periodicals, the production of books and the number of libraries opened is said to afford a striking testimony to the progress made. The undertakings of governmental ministries and transport developments are also intimately connected with this cultural progress, and while new railways have been laid, air services opened, postal, telegraphic and telephonic communications improved and extended in remote areas, much still remains to be completed and such work already in hand is depicted as though it stood, like an artist's unfinished picture, upon an easel.

The Brno exhibition is arranged to show the close interrelationship between the state, the sciences and general culture. The spread of ideas through the receipt of foreign journals and news is expressed by a long aisle, the white walls of which have dark lines to represent railway tracks. The engineering difficulties encountered in duplicating lines in poorly served areas have brought together specialists in different branches of pure and applied science, and such connections are indicated. Other links, such as that of the Ministry of Health with the radium exhibit from Jáchymov and the products from other curative spas, are emphasized. The recent growth of towns, urbanism, is depicted by statistical designs among small-scale apparatus illustrating the latest methods in purifying water supplies, generating electricity, etc. Sciences concerned with inanimate matter and those which are observational and descriptive occupy the ground floor; the mathematical sciences are above, while the philosophical studies are placed still higher. *Nature* says that architecturally the main hall is a surprise of impressive spaciousness. The graceful parabolas of concrete admit a maximum of light; smaller surrounding pavilions contain exhibits of the public works of important towns and the arts sections of culture.

### THE CHARTING OF THE HAWAIIAN ISLANDS

THE U. S. Coast and Geodetic Survey reports that the S. S. *Guide*, after completing the work of charting on the Kona coast of the Island of Hawaii, proceeded to the northwest islands of the Hawaiian group. The work there is the beginning of an extended program of latitude and longitude observations, determinations of gravity, measurements of magnetic declination and intensity, charting and topographic mapping. These small islands have needed such observations in order that they may be accurately charted. Their positions have heretofore been located for the most part by sextant observations only.

The geological aspect of these islands has been considered by Professor Harold S. Palmer, of the Bishop Museum. They are uninhabited, and have been given little attention in the way of scientific investigations and surveys. It is believed that these are the older islands of the Hawaiian group and that they were at one time high volcanic cones, now reduced by erosion to projecting fragments and shoals.

The *Guide* has completed the first trip of three weeks to Nihoa and Necker Islands and to French Frigates Shoal. On Nihoa an astronomic station was occupied, where latitude, longitude and azimuth were determined. Observations were also made for gravity and for magnetic declination. A topographic map of the island was made on the scale of 1:2,500. Some difficulty due to heavy seas attended the first attempt

to go ashore on the island. The boat carrying the scientific party with instruments and supplies was capsized during the landing, but the instruments were for the most part recovered and there were no casualties.

Observations were to have been made on Necker Island, but rough weather made landing there impracticable. The ship therefore proceeded to French Frigates Shoal, where on East Island the same observations were made as on Nihoa. Triangulation was also started, and more complete magnetic observations were made at this place.

The ship returned to Honolulu for supplies and fuel, and has started on a second trip to these islands. Another attempt will be made to occupy Necker to make there the same observations that have been completed at Nihoa and French Frigates Shoal, and to continue the triangulation work at the latter place.

The program contemplates continuing these observations on through the islands to the northwest as far as Ocean Island, if conditions permit, perhaps representing several seasons' work. For the longitude and gravity observations radio time signals are received direct from the Arlington station near Washington, D. C. Lieutenants Brown, Bainbridge and Simmons, who did geodetic work on the Island of Hawaii about a year and a half ago, are the observers in this present work.

## SCIENTIFIC AND TECHNICAL COURSES OF THE BUREAU OF STANDARDS

SCIENTIFIC and technical courses will be given at the Bureau of Standards beginning on October 1. The courses are open to all properly qualified students as well as to members of the staff. The subjects covered this year are: Advanced optics, Fourier series and spherical harmonics, Newtonian potential function, Einstein's relativity and theory, analytical mechanics, chemical thermodynamics, advanced inorganic chemistry, ceramic petrography, Heaviside's electrical circuit theory and elementary ceramics.

Each course will be given by an expert in that particular field, the instructors being Dr. T. L. de Bruin, of the University of Amsterdam, and research fellow of the International Education Board; Dr. Tobias Danzig, of the University of Maryland; Dr. L. H. Adams, of the Geophysical Laboratory; Dr. Louis Cohen, of the Signal Corps Research Laboratory; and Dr. Paul R. Heyl, Dr. Raleigh Gilchrist, Dr. Herbert Insley and R. V. Stull, of the Bureau of Standards.

These educational courses of the bureau were started twenty years ago, and each year an opportunity has been given to the younger men and women on the bureau's staff and outside to perfect themselves in physics, chemistry, mathematics and allied subjects. Authority for the work is contained in a joint resolution of the congress in 1892, opening the government's bureaus for research and educational purposes.

The fees charged place the work on a self-supporting basis, nearly every year showing a small increase in the reserve fund which is added to the sum available to pay the expenses of instructors, prepare the necessary copies of lectures and carry the work through occasional "lean years."

The enrolment has increased slowly but steadily. At the present time about 90 students have enrolled for the coming season. The number will probably be about 120 by October 1.

The work is under the supervision of an educational committee, consisting of four members appointed by the director of the bureau and two elected by the students. The chairman for the past eight years has been Dr. L. B. Tuckerman, of the engineering mechanics section and an internationally known expert on the theory of structures.

Complete information on the courses for the coming year may be obtained by addressing the Educational Committee, Bureau of Standards.

## THE SMITHSONIAN INSTITUTION AND MR. ORVILLE WRIGHT

IN an attempt to clarify the Smithsonian Institution's position on the Langley-Wright controversy, to correct errors, where errors have been made, and to do justice alike to three great pioneers of human flight—Wilbur and Orville Wright and Samuel Pierpont Langley—as well as to the Smithsonian, Secretary Charles G. Abbot has made public a comprehensive statement (Smithsonian Publication No. 2977). In this he takes up individually what he understands to be Mr. Orville Wright's grievances against the institution.

Pointing out that since his election as secretary in January, 1928, he had sought to end the controversy, Dr. Abbot reviews the history of the institution's relations with the Wright brothers. He lists seven points to illustrate the recognition by the Smithsonian of the Wrights' achievement in being the first to make sustained human flights in a power-propelled, heavier-than-air machine. This recognition includes the publication of articles by the Wright brothers in the Smithsonian Annual Reports for 1902 and 1914, and of other articles descriptive of their achievements; the award to the Wright brothers of the first Langley Gold Medal for Aeronautics; the request made in 1910 for Wright planes, including the Kitty Hawk plane, to be exhibited in the National Museum, and the public exhibition in the museum of the Wright plane of 1908 (deposited by the War Department)

and of all material obtainable on the Wright achievements.

He then lists and discusses six points regarding which he understands Mr. Orville Wright feels that the Smithsonian has dealt unjustly with his brother and himself, as outlined to Dr. Abbot in a friendly conference he had with Mr. Wright last April.

Dr. Abbot again invites Mr. Wright to deposit the Kitty Hawk plane in the U. S. National Museum. He expresses regret that any statements should have been promulgated by the Smithsonian Institution which might be interpreted to Mr. Wright's disadvantage, and that the experiments of 1914 with the Langley plane should have been undertaken and described in a way to give offense to Mr. Orville Wright and his friends.

"Finally," says Dr. Abbot, "as a further gesture of good will, I am willing to let Langley's fame rest on its merits, and have directed that the label on the Langley Aerodrome shall be so modified as to tell nothing but facts, without additions of opinion as to the accomplishments of Langley. This label now reads as follows:

LANGLEY AERODROME
THE ORIGINAL SAMUEL PIERPONT LANGLEY FLYING MACHINE OF 1903, RESTORED. DEPOSITED BY THE SMITHSONIAN INSTITUTION

## SCIENTIFIC NOTES AND NEWS

PROFESSOR RAYMOND PEARL, of the Johns Hopkins University, was elected president of the International Union for the Study of Demographic Problems recently organized in Paris. The work will have its headquarters in Paris and will hold its first international meeting in Rome in 1931.

PROFESSOR EARLE R. HEDRICK, chairman of the department of mathematics of the University of California at Los Angeles, has been nominated for the presidency by the council of the American Mathematical Society.

DR. WILLIAM CHARLES WHITE, of the Hygiene Laboratory, U. S. Public Health Service, Washington, D. C., assumed his work as chairman of the division of medical sciences of the National Research Council on September 15, succeeding Dr. Howard T. Karsner, of Western Reserve University.

CLAUDE BURTON HUTCHISON, director of agricultural education in Europe for the Rockefeller International Education Board, has been named director of the Giannini Foundation for Agricultural Economics in the College of Agriculture of the University of California. He will begin his work at the university on October 15.

AT the recent meeting of the council of the American Chemical Society at Swampscott, Dr. H. T. Clarke and Dr. R. A. Gortner were elected associate editors of the *Journal* of the American Chemical Society to succeed Dr. J. F. Norris and Dr. C. F. Alsberg. Dr. Gortner and Dr. F. B. Kendrick were elected associate editors of *The Journal of Physical Chemistry,* to succeed Dr. John Johnston and Dr. H. B. Weiser.

SIR JOSIAH STAMP has been elected treasurer of the British Association for the Advancement of Science, in succession to Dr. Ernest H. Griffiths, formerly principal and professor of experimental philosophy in University College, South Wales.

DR. PERCY E. RAYMOND, professor of paleontology at Harvard University, has been given the Walker Grand Prize of $1,000, for his research on trilobites.

AT a meeting of the Royal Faculty of Physicians and Surgeons of Glasgow held on September 3, the honorary fellowship was conferred upon Sir Arthur Keith, F.R.S. During the course of an "at home," given in the faculty hall to members of the British Association for the Advancement of Science, Sir Arthur Keith signed the roll of honorary fellows. Last year Sir Arthur was president of the British Association.

LEIGHTON W. ROGERS has been appointed executive officer of the International Civil Aeronautics Conference to be held in Washington from December 12 to 14. Mr. Rogers assumes his work at once under the direction of an executive committee headed by the assistant secretary of commerce for aeronautics, William P. MacCracken, Jr.

ERIC ENGLUND has been appointed to take charge of the division of agricultural finance of the bureau of agricultural economics, U. S. Department of Agriculture.

DR. C. W. BENNETT has resigned his position as assistant professor of plant pathology in the Michigan State College and has accepted an appointment as associate in plant pathology at the Ohio Agricultural Experiment Station. Dr. Bennett will continue his research work on raspberry virus diseases and peach "yellows."

I. MCGUIRE, formerly assistant librarian at the California Academy of Sciences, is now in charge of the Guyot Hall Library (natural sciences) at Princeton University.

DR. MARCUS REINER will arrive in America about October 1 to study viscous and plastic flow in the chemical department of Lafayette College.

DR. GREGORY D. WALCOTT, technically on leave of absence from Hamline University during the academic year, 1928–29, is in charge of courses on "Modern Thought," at Long Island University, Brooklyn, N. Y., for the first semester, 1928–29.

PROFESSOR ALBERT BRACHET, formerly rector of the University of Brussels, Belgium, has accepted appointment as a visiting professor from Belgium for the year 1928–29, under the auspices of the C. R. B. Educational Foundation. In 1927 Dr. Brachet was the president of the Association of Anatomists at the congress in London. He is prepared to deliver lectures on biological subjects related to embryology in English, as well as a general lecture regarding scientific progress in Europe in French. Dr. Brachet will arrive in the United States at the end of November.

DR. PAUL WOLDSTEDT, one of the forty geologists of the Prussian Geological Survey, is visiting the United States. He plans to conduct extensive studies of the glacial deposits in the northern portion of the United States and the southern part of Canada. While here he will be the guest of various specialists in different parts of the continent.

DR. A. L. DAY, director of the geophysical laboratory of the Carnegie Institution of Washington, and H. O. Wood, in charge of the laboratory of seismology of the Carnegie Institution and the California Institute of Technology, recently visited the Scripps Institution of Oceanography at the University of California. Dr. Day is chairman of the committee on seismology of the Carnegie Institution and inspected the seismographs installed at the Scripps Institution. A conference with Director T. Wayland Vaughan was held in discussion of problems of marine sediments and of the chemistry of sea-water.

DR. A. S. HITCHCOCK, custodian of grasses in the National Herbarium, has returned to Washington. He spent the month of June studying at the New York Botanical Garden and the Gray Herbarium. He then went to Newfoundland, making collections at Port-aux-Basques, St. Georges, Corner Brook, Little Harbor, Grand Falls and St. Johns. A short trip to Labrador gave opportunity for collecting at Cartwright and Battle Harbor.

HOWARD E. SIMPSON, professor in the department of geology of the University of North Dakota and state water geologist, has returned to Grand Forks after a year's absence on sabbatical leave. During the year he has been largely engaged as consulting water geologist in making ground water surveys for new or improved water supplies.

H. A. WADSWORTH, assistant professor of irrigation investigations and practice and assistant irrigation engineer of the University of California, has been granted a year's leave of absence to organize irrigation work at the University of Hawaii.

MRS. C. B. S. HODSON, of London, who for some years has been secretary of the British Eugenics Society and administrative secretary of the International Federation of Eugenic Organizations, will arrive in the United States at the end of October for a four months' lecture and observation tour.

SIR JOHN RUSSELL, of the Rothamsted Experimental Station, completed at the end of July a study of Australian agriculture, especially of irrigation, in which he had the cooperation of universities, state departments of agriculture and the Council for Scientific and Industrial Research. Sir John is now making a similar study in New Zealand.

AT the International Congress of Mathematicians held at Bologna, Professor Edward Kasner, of Columbia University, presented papers on "Geometrie des fonctions polygène" and "The Higher Derivatives of Polygenic Functions."

THE New York Post-Graduate School and Hospital has arranged for special lectures during October. The lectures include: October 2, Sir Farquhar Buzzard, regius professor of medicine of the University of Oxford, "What is Neurasthenia?"; October 6, Professor Vittorio Putti, director, Instituto Ortopedico Rizzoli, Bologna, Italy, "Some Aspects of Orthopedic Surgery"; October 19, Professor Archibald Young, regius professor of surgery, University of Glasgow, Scotland, "Some Aspects of Modern Surgery."

FRANK P. MCKIBBEN, consulting and bridge engineer, has undertaken a lecture tour throughout the United States under the auspices of the General Electric Company, on the application of electric arc welding to the noiseless construction of buildings. Lectures in some forty cities have been arranged. The opening lecture was in Rochester on October 4, the last lecture announced being at Chapel Hill before the North Carolina Society of Engineers on March 4, 1929.

THE sixth Lloyd Roberts Lecture has been arranged by the Royal Society of Medicine for November 29. It will be delivered by Sir William Bragg, F.R.S., this year's president of the British Association for the Advancement of Science.

THE late Dr. William Stewart Halsted, who was professor of surgery in the Johns Hopkins University and surgeon-in-chief of the Johns Hopkins Hospital from the date of its opening in 1889 until his death on September 7, 1922, would have been seventy years old on the twenty-third of that month. A committee of his colleagues decided that the most suitable commemoration of this anniversary would be the publication of his collected papers, and it is known that this form of recognition would have been the one most acceptable to Dr. Halsted himself. It is believed that such a publication remains a most fitting memorial of Dr. Halsted's life and work. The two volumes have now been issued by the Johns Hopkins University Press under the title "Surgical Papers, by William Stewart Halsted."

BRIGADIER-GENERAL WILLIAM HERBERT BIXBY, U. S. A., retired, distinguished for his work on bridges, rivers and harbors, died in Washington on September 29, aged seventy-nine years.

COLONEL FREDERICK VAUGHAN ABBOT, U. S. A., retired, who for forty years occupied a leading position in the corps of engineers, died at Nonquitt, Massachusetts, on September 26 at the age of seventy years. Colonel Abbot was the son of Brigadier-General Henry L. Abbot, one of the most distinguished army engineers, who died a year ago at the age of ninety-six years.

PROFESSOR JOHN G. PERTSCH, JR., of the school of electrical engineering of Cornell University, was drowned in Cayuga Lake on August 23, when he attempted to rescue Miss Signe Sjoegren, formerly assistant medical adviser at Cornell.

THE Clinical Congress of the American College of Surgeons will be held in Boston this year from October 8 to 12. The Hunterian oration of the college will be delivered by the editor of the *Lancet*, Sir Squire Sprigge, upon whom the honorary fellowship of the college will be conferred.

THE American Association of Cereal Chemists will meet in 1929 in Kansas City during the second week in May.

A MEETING of the International Scientific Radio Union was recently held in Brussels to consider means of accelerating the advancement of practical applications of radio-electrical science. On the initiative of M. Robert Goldschmidt, the Belgian secretary-general of the union, who contributed 200,000 francs as a first gift, it has been decided to establish in Brussels a radio-telegraphic experimental center.

THERE was a meeting on September 17 of shade-tree specialists at the Bartlett Tree Research Laboratories, Stamford, Connecticut. The morning was devoted to scientific papers, Dr. E. P. Felt, director and chief entomologist, briefly outlined the aims and purposes of the laboratory and summarized the more important insect developments of the season. Dr. Carl Deuber, physiologist, discussed the mineral requirements of shade trees. Dr. W. H. Rankin, chief pathologist, gave a paper on cavity treatment and injections, and Mr. Rush P. Marshall, pathologist, discussed a series of tests on the value of various wound dressings. Mr. A. F. Burgess, in charge of the federal gypsy moth work, Professor C. C. Hamilton, associate entomologist of the New Jersey Agricultural Experiment Station, Dr. W. E. Britton, state entomologist of Connecticut, all gave brief talks on the insects of the season. Professor G. P. Clinton, botanist, and Professor W. O. Filley, forester of the Connecticut Agricultural Experiment Station, briefly discussed the recently discovered willow disease and the work and aims of the Connecticut Tree Protection Board, respectively. Professor S. P. Hollister, of the Connecticut Agricultural College, gave a talk on grafting.

THE New York Botanical Garden announces the following series of illustrated public lectures to be held in the museum building on successive Saturday afternoons at four o'clock, beginning on October 6: "Diatoms, Microscopic Beauties," Dr. M. A. Howe; "Autumn Coloration," Dr. A. B. Stout; "Plants that are Attractive in Fruit," Mr. Kenneth R. Boynton; "South American Wild Life," Mr. Leo E. Miller; "History of Landscape Gardening," Professor H. Findlay; "Philippine Life," Dr. Forman T. McLean; "Some Interrelations between Botany and Geology," Dr. Arthur Hollick; and "Java and the Javanese People," Dr. H. A. Gleason.

THE editorial staff of *Animal Breeding*, a bi-monthly journal which is to make its first appearance in January, 1929, is as follows: Professor L. J. Cole, of the department of genetics, University of Wisconsin, editor-in-chief; Dr. W. A. Lippincott, head of the poultry husbandry division of the college of agriculture, University of California; Dr. F. A. E. Crew, of the University of Edinburgh; Dr. L. C. Dunn, of Columbia University; Hans Nachtsheim, of the Institut für Vererbungsforschung, Berlin; Dr. Raymond Pearl, of the Johns Hopkins University; and Dr. Sewall Wright, of the University of Chicago.

AN observatory is being erected in Mill Hill Park, Hendon, by University College, London, to house a large astronomical telescope which has been presented to the college. It was formerly the property of Mr. W. E. Wilson, F.R.S.

THE *Journal* of the American Medical Association reports that the University of Pennsylvania Graduate School of Medicine has received a gift of $100,000 for the purchase of a gram of radium and accessories for use in the treatment of cancer. The donor was Mr. Louis J. Kolb, of Germantown, who graduated from the University of Pennsylvania in 1887. About $72,000 of the gift will be required to buy the radium and the remainder will go to expenses involved in research. The gift will make possible the treatment with radium of the neediest patient with cancer. The fund will be designated as the Louis J. Kolb Foundation for the Treatment of Cancer, and Dr. George E. Pfahler, professor of radiology, will be in charge. Dr. Pfahler is a former president of the American Roentgen Ray Society and is now visiting the more noted cancer clinics in Europe. The Kolb gift is the second which the university has recently received to fight cancer, Irénée du Pont having contributed $45,000 for cancer research. As a result of Mr. du Pont's gift the physicochemical conditions associated with the cancer state are being studied under the direction of a faculty committee, comprising Dr. E. Ellice McDonald, assistant professor of gynecology, Dr. William C. Seifriz, professor of botany, and Dr. George H. Meeker, dean of the graduate school of medicine.

THE Mitre Institution at Buenos Aires, which is designed to stimulate scientific and artistic activities, has awarded the following prizes for experimental work on some parasitic disease of the country: The first prize of 2,500 pesos was awarded to the late Dr. Carlos Lagos García for a clinical study on pulmonary hydatid cysts in children, based on a twenty years' collection of 120 observations. Dr. García's death occurred a few hours after the decision of the board. A second prize of 1,000 pesos was awarded to Dr. F. Niño for his work on American trypanosomiasis. The usual prize for medicine was awarded to M. Royer for his research work on urobilin; the prize for pharmacy was given to J. Folcini for a study on the different effects derived from fluorine and diphenyl, and the prize for odontology was won by J. Chanelles for his work on Howe's use of silver nitrate in the treatment of dental caries. Two other prizes of 500 pesos and a gold medal were awarded for the best research work of the university alumni.

## UNIVERSITY AND EDUCATIONAL NOTES

BY the will of George W. LeFevre, who died on August 13 in Paris, Cornell University is made his residuary legatee. The university will receive the sum of $250,000, the income of which will be used yearly in payment of scholarships of the value of $400 to students successful in passing special examinations, the bequest having been made "to advance the interest and usefulness of Cornell University and to aid and encourage young men and women of superior ability."

THE will of Miss Mary Senter Mandelle, who died at Stonington, Connecticut, on August 17, leaves the bulk of a $2,000,000 estate to charitable and educational institutions. Kalamazoo College receives $350,000 for a new library and the University of Michigan $60,000 for six scholarships.

DR. WALLER S. LEATHERS, associate dean, has become dean of the School of Medicine of Vanderbilt University, succeeding Dr. G. Canby Robinson, who resigned to accept the position of director of the Cornell University Medical Center, New York City.

DR. G. I. CHRISTIE, director of the station and the department of agricultural extension of Purdue University, has accepted the presidency of the Ontario Agricultural College, to succeed Dr. J. B. Reynolds.

PROFESSOR E. W. BOWLER will be the head of the recently established department of civil engineering of the college of technology of the University of New Hampshire.

DR. ARTHUR WEIL, formerly neuropathologist to the Montefiore Hospital, New York, has returned from Europe to take up his work as assistant professor of neuropathology in the institute of neurology at Northwestern University Medical School. The institute, which was organized last February, now has on its staff five men: Dr. S. W. Ranson, Dr. J. C. Hinsey, Dr. A. Weil, Dr. H. A. Davenport and Dr. H. H. Dixon, all of whom are devoting their entire time to neurological research.

EDWARD R. LINNER, of the University of Wisconsin, and William F. Hart, of Princeton University, have joined the chemical staff of Lafayette College.

DR. PETER CARODEMOS, of the New York Experimental Station at Geneva, has been appointed associate professor of chemistry.

H. S. JACKSON, chief of the department of botany, Indiana Agricultural Experiment Station, Lafayette, has accepted a call to the professorship of mycology and cryptogamic botany at the University of Toronto, the appointment to take effect on January 1. Professor Jackson is well known for his work on the rust fungi. He succeeds Professor J. H. Faull, who recently accepted a professorship at Harvard University.

# DISCUSSION AND CORRESPONDENCE

## NEWTON'S LAW OF GRAVITATION—A DANGER SIGNAL

THE writer is fully aware of the fact that it is very much easier to criticize adversely a book on physics than it is to write a reliable text in this field. On the other hand, he has also observed that it is almost impossible to eradicate an error when it has once obtained a start through the prestige of the name of a noted scientist. A brief history of a case of this kind is recorded on page 127 of the second edition of "The Principles and Methods of Geometrical Optics" by James P. C. Southall. But, in my opinion, errors are not as serious in advanced works as in text-books written for college students, since investigators think independently, whereas the undergraduate usually considers anything printed in a book adopted by his instructor to be absolutely unimpeachable, quite regardless of whether the author is a novice in the art of exact expression or an old, seasoned writer. Among the relatively large number of text-books on physics submitted to me recently for examination two contain an altogether gratuitous inexactness of statement of Newton's law of gravitation which should not be allowed to pass unnoticed. It is especially desirable to call attention to this matter because it is highly probable that these two volumes will influence a large number of students.

"Any two bodies attract each other with a force proportional to the product of their masses (*i.e.*, to the amount of matter they contain) and inversely proportional to the square of the distance between them." ". . . when the distance between them is *d*." Again: "Any two bodies in the universe attract each other with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them." ". . . *d* the distance between their centers, . . ."

The book from which the first quotations were made is extremely misleading with respect to the meaning of the word "distance" and the second text adds confusion by referring to an undefined "center." For illustration, what is *the* center of a plane triangular lamina of homogeneous material? Is it the center of mass, or the center of the inscribed circle, or of the circumscribed circle, or of an escribed circle, or the intersection of the altitude lines, etc.? Taking the law as stated and implied, what would be the value found by a student for the force between a homogeneous sphere and an exactly concentric enclosing homogeneous spherical shell of finite thickness of wall? If the distance (zero) between the centers is taken the result will be infinite; if the radial distance between the outer surface of the solid sphere and the inner surface of the enveloping shell is taken the result will be variable. In marked contrast with the above citations is the presentation in article 6, page 139, of another very recent book, the one by A. A. Knowlton.

It would be helpful to many students if they were afforded the opportunity of mastering the following extremely simple case. Let a mass $M$ (or the center of a homogeneous sphere) coincide with the geometrical center of an arc of a circle (or wire of negligible cross-section) along which a mass $m$ is uniformly distributed. Let the radius of the arc and the angle subtended at $M$ by the extremities of the arc be respectively $a$ and $2\theta$. The force along the bisector of the angle $2\theta$ is given correctly by

$$F = (GmM \sin\theta)/(a^2\theta).$$

If the mass $m$ were concentrated at a point on this bisector at a distance $x_1$ from $M$, the same force would be exerted when

$$x_1 = a\theta^{\frac{1}{2}}(\sin\theta)^{\frac{1}{2}}.$$

The center of mass of the arc is situated at

$$\bar{x} = (a \sin\theta)/\theta.$$

If "center" in the second quotation means the middle point of the arc the force will be

$$F' = (GMm)/a^2 = (\theta F)/\sin\theta.$$

If "center" signifies the center of mass the force will be

$$F'' = (GMm\theta^2)/(a \sin\theta)^2 = (\theta^3 F)/(\sin\theta)^3.$$

The errors in per cent. may be read from the following table.

| $\theta$ | $100\,F'/F$ | $100F''/F$ |
|---|---|---|
| 0 | 100. | 100. |
| $\pi/6$ | $100\pi/3 = 104.72$ | $100\pi^3/27 = 114.84$ |
| $\pi/4$ | $100\pi/2^{3/2} = 111.07$ | $100\pi^3/2^{5/2} = 137.03$ |
| $\pi/3$ | $200\pi/3^{3/2} = 120.92$ | $800\pi^3/3^{5/2} = 176.80$ |
| $\pi/2$ | $100\pi/2 = 157.08$ | $100\pi^3/8 = 387.58$ |

Also, when

$$\theta = \pi/4,\ x_1 = 1.0539a \text{ and } \bar{x} = 0.9003a.$$

H. S. UHLER

## THE PRAIRIES AGAIN

THE explanation of the cause of the treelessness of the prairies, offered by Professor Jones in SCIENCE for October 7, 1927, represents one of those cases, especially numerous in this field, in which broad generalizations are based on rather limited observations. It is therein assumed that rapid drainage of postglacial waters was responsible for the establishment of the prairie flora.

In Illinois, Iowa, northern Missouri, Nebraska and portions of other states, there are extensive deposits of loess, the rougher portions of which are still covered with a prairie flora, though a large part of the former prairie is now under cultivation.

This loess, where it appears at the surface (it is sometimes interglacial), is a distinctly post-glacial deposit gradually built up by winds from the dust of sandbars, dunes, etc. In western Iowa it sometimes exceeds one hundred feet in thickness, and in other parts of the region frequently runs from fifteen to thirty-five feet.

This deposit was formed *after* the post-glacial drainage—most of it long after—for the deposition was evidently comparatively slow. The terrestrial molluscan fauna of the loess clearly points to a well-drained surface (in many cases distinctly dry), formed in a mild climate long after glacial conditions had ceased. There could have been no rapid drainage of glacial waters on these areas, and the explanation fails for all the loess-covered prairie areas.

It fails for the sharp loess ridges in western Iowa and Missouri which have forest on the sheltered side and prairie on the exposed side, though the slope and soil are essentially the same. During the more than forty years that the writer has studied these ridges there has been no noticeable change in the line between forest and prairie.

It fails for the driftless, or nearly driftless, area of northeastern Iowa and southwestern Wisconsin, on which prairie areas are still found.

It fails utterly for the "prairie openings" found on every type of soil in the rougher wooded sections of the prairie region.

It fails also for such regions as the Kansan drift area, covering a large part of Iowa south and west, a large part of which was treeless. The Kansan surface was deeply eroded, undoubtedly long after the recession of the glaciers, and over much of it deposits of loess were formed even after the erosion.

It clearly fails also for the alluvial prairies. Many of our stream valleys show alternating forest and prairie areas, according to exposure to drying atmospheric factors. In most of these cases the drainage has been essentially the same and the differences in flora can not be explained by merely assuming a subsequent advance of the forest.

Post-glacial drainage fails to explain another type—the sandy prairie on fixed dunes such as occur in Muscatine and Harrison counties, Iowa, on the treeless parts of the dunes at Gary and Miller, Indiana, and elsewhere. The flora of these open fixed dunes consists in large part, or wholly, of prairie plants. There was no rapid drainage here, yet the prairie flora is established.

Finally, it fails for the large prairie areas in southern Kansas, Arkansas, Oklahoma and Texas, far below the limit of glacial ice, and where there is absolutely no evidence that the surfaces were swept by glacial waters.

Professor Jones does not regard the grasses of the prairies as a climax stage and states that the forests are gradually encroaching upon them.

It should be noted that over large prairie areas grasses did not (and do not) constitute the dominant vegetation, but numerous other plants, especially Compositae and Leguminosae, formed the conspicuous part of the flora.

That the prairie flora represents a climax stage is shown by the following facts:

(1) The flora has persisted, in many cases in strips of ten to twenty feet in width, through many years without material change.

(2) Where the prairie turf has been broken or disturbed the disturbed areas are first invaded by native "prairie weeds" (often with introduced weeds), but in the course of a few seasons the prairie flora comes back.[1]

(3) Thousands of acres of the prairie groves have perished, and most of them in the prairie region proper would do so in time if man did not change conditions by planting and cultivation and by creating protected zones by erecting buildings and planting shelterbelts. Their areas were again occupied by the prairie flora where cultivation did not interfere.

It should also be noted that there has been no such general natural invasion of the prairie by forest as might be inferred from statements of some recent writers. Where changes have occurred along the borders they represent comparatively slight fluctuations, caused by alternating wet and dry cycles of seasons. They are quite as likely to be retreats as advances. In favored places the forest may extend itself over ridges by the protection afforded by its own border trees, but this is not general. Where contour lines break abruptly, the line between prairie and forest is quite sure to be sharp and constant.

In SCIENCE of December 30, 1927, Professor Arthur M. Miller controverts Professor Jones' arguments concerning the origin of the prairies, and presents his explanation of the treelessness of the Kentucky "Barrens," stating that "aided possibly by forest fires, vast herds of buffalo and deer and elk were able to reclaim it from the forest."

[1] For discussion of specific cases see writer's "Papers on the Prairie" in University of Iowa Studies in Natural History, Vol. XI, No. 5, 1925.

While Professor Miller offers this as a local and not a general explanation, the bison and fires have been regarded as general causes.[2]

Even if we concede the accuracy of the maps, records and traditions cited, the explanation is not convincing, even for the particular area. As a general cause, however, applicable to the entire prairie region, it is wholly untenable. The objections to it may be briefly stated as follows:

(1) Larger herds of bison, etc., disappeared from Iowa long before the white man settled the state, yet the prairie has held its own even to the present.

(2) The sharp loess ridges in western Iowa and Missouri, already noted, with their sharply defined prairie and forested slopes, also militate against this theory.

(3) Many of the prairie slopes in western and northeastern Iowa are so steep that heavy animals like the bison would find a footing with difficulty and would not be tempted to use such places when more accessible prairie pastures were abundant nearby.

(4) The number of animals necessary to keep the prairie treeless would be vastly greater than anything the oldest records suggest. There are not even traditions of such large herds as would be postulated by this theory. In Iowa alone there were more than forty thousand square miles of prairie.

(5) The numerous prairie openings (true prairie, as shown by the flora) which are scattered through the groves and forests of the general prairie region, could not have been formed in this way. During the more than fifty years that the writer has observed these openings they have maintained their prairie characteristics, yet the bison is a mere faint tradition in this region.

(6) The association of the bison and fires as a cause is contradictory. If the bison kept the prairie closely cropped where did the fires find fuel?

The flora of the prairies is distinctly xerophytic, and its presence upon the areas which we call "prairies" is determined by those ecological factors which make for xerophytism.

B. SHIMEK

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## ON CHANGING FAMILY NAMES

WITH Professor Bradley's proposition (SCIENCE, LXVIII, 1928, pp. 102–104) to allow the same rules to operate in selecting the type genus of a family as in selecting the type species of a genus the writer is in entire accord. He does not, however, accept Professor Bradley's proposed regulation to cover changes of family names, and, in place of his proposed Article 5, would substitute:

> Art. 5. When the name of the type genus of a family or subfamily is found to be a homonym or synonym, the family or subfamily takes the next oldest valid name.

This is in accord with the principles involved in changing a generic name. When such a name must be changed, it is not insisted that the new name be based on the same type species as the invalid name—as Professor Bradley insists that the new family name must be based on the same type genus as the old—but the next oldest name is used, a name that may frequently be based on a type subgenerically distinct from the first type species.

The writer feels that his proposal is superior to Professor Bradley's for the following reasons: (1) It carries out consistently as applied to the selection of the type genera of families and subfamilies the same principles now utilized in the selection of the type species of genera and subgenera. (2) In cases where different authors have used different names for the same family or subfamily and the oldest of these becomes invalid, it allows for the introduction of the next oldest already more or less familiar name rather than the creation of an entirely new and strange name.

MELVILLE H. HATCH

UNIVERSITY OF WASHINGTON

## OBSERVATIONS IN PERU

IN "Science News" (SCIENCE for August 3) there is mention of the earthquakes in and along the northern coast of Peru. Here at Negritos, which is located just about one mile northeast of Pt. Parinas (Lat. 4° 40′ 15″ South; Lon. 81° 20′ 5.9″ West), we felt the quakes, which were strong enough to cause the hanging electric lights to swing and to be felt by persons seated and standing. However, in my laboratory a wash bottle flask of one liter capacity which was standing on its head was not upset. This would seem to show that here the shocks were not very strong.

It may also be of interest to some of the readers of SCIENCE to know that on the 17th of August we had a very red and long-lasting sunset. It was most unusual for this season of the year. The sky was very bright well up to about two thirds of the way to the zenith, the light lasted about one hour later than the normal sunset glow (which here is usually short). The two nights following were also fairly red but much shorter glow and less color. The why of this I do not know unless it was the volcanic eruption in or near Batavia, in Java, as reported in the paper of August 10 (*El Tempo*, Piura, Peru).

E. WILLARD BERRY

NEGRITOS, PERU

[2] Harshberger, John W., "Phytogeographic Survey of North America," 1911, p. 517; Campbell, D. H., "An Outline of Plant Geography," 1926, pp. 106, 107.

## ETHNOLOGICAL AND ARCHEOLOGICAL COOPERATIVE INVESTIGATION UNDER THE SMITHSONIAN INSTITUTION

IN response to a recent inquiry the Smithsonian Institution has requested the Comptroller General of the United States for an opinion as to the geographic limits included under the special appropriation for cooperative ethnological and archeological researches under the Bureau of American Ethnology.[1] Under date of August 31 reply has been received that expenditures under this appropriation under the wording of the act may be made only within the geographic limits of the United States proper, and may not be extended to the territories of Alaska or Hawaii, or to any other areas which may be under the jurisdiction of the United States but outside of its geographic limits.

C. G. ABBOT,
*Secretary, Smithsonian Institution*

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## QUOTATIONS

### CHEMICAL ABSTRACTS

THE directors of The American Chemical Society a few months ago addressed a proposal to the society's corporate members, to a selected list of corporations whose prosperity depends on chemistry, and to a few individuals believed to be able, by support, influence, or advice, to assist in carrying out the plan unfolded for the expansion of "Chemical Abstracts." It was pointed out that two things were essential: first, the investment of not less than $50,000 a year in addition to funds which could be taken from the society's resources to enable "Chemical Abstracts" to fulfil its mission; second, the creation of a capital sum, the income of which is to be devoted to the continuation of that work.

The society had turned but seldom to industry for substantial assistance, and some doubted the success of the undertaking. At the St. Louis meeting the group was electrified by the announcement that the Chemical Foundation, Inc., through its president, Francis P. Garvan, had made available the sum of $50,000 per year for five years to be used in such manner as the directors of the society should decide for the development of "Chemical Abstracts." It was also announced that already a considerable sum had been offered by industry, headed by an annual gift of $10,000 for five years from the Allied Chemical & Dye Corp. The announcement of these additional sums further encouraged those responsible for financing the society's programs, since it enabled the directors to complete their part of the agreement with the General Education Board, whose support of the Second Decennial Index to "Chemical Abstracts" was on the basis of a revolving fund to be brought to $100,000 to guarantee the future compilation and publication of such collective indexes.

Since that memorable St. Louis meeting the work has gone forward in a dignified, quiet, yet persistent way, and it has been most heartening to see the splendid spirit with which the industry has responded to the proposal made by the directors. To-day we are able to publish a list of those who have invested in the expansion of "Chemical Abstracts" and, in accordance with the instructions issued by the directors to the secretary of the society, amounts have been indicated only with the consent of the company and where $500 a year or more is involved. We are delighted to announce that industry has met the proposal and that for the next five years "Chemical Abstracts" will expend, in addition to sums from the resources of the society of not less than $110,000 a year, $50,000 on this key to the chemical literature of the world.

The total of one quarter of a million dollars, made available by the Chemical Foundation, becomes the nucleus of a capital sum necessary to guarantee in perpetuity this much-needed support. The work, therefore, is but partially completed, but what has been accomplished will surely facilitate the completion of the effort.

It may not be generally known that in 1927 "Chemical Abstracts" published 32,909 abstracts, of which 7,872 were abstracts of patents. This was an increase of more than 3,700 abstracts in comparison with 1926, which was again nearly as great an increase over 1925. . . .

The number of scientific journals now systematically abstracted is more than 1,300, and they represent many languages. The published "List of Periodicals Abstracted by Chemical Abstracts with Key to Library Files" (225 American and Canadian libraries) is an 89-page pamphlet, available at 35 cents per copy, and said to be by far the most complete list in existence of current periodicals of chemical interest.

"Chemical Abstracts" will continue to strive to excel in completeness, so that the chemist can use abstracts with a feeling of reasonable security against missing anything of value in contemporary chemical literature. The quality of the abstracts, which has been good in spite of the necessity for extreme brevity, will be improved by the reasonable lengthening which is now possible. These abstracts are, for the most part, prepared by specialists actively interested in the various

[1] See SCIENCE, July 13, 1928, pp. 29–30.

subjects. Other specialists serving in the capacity of assistant editors, of which there are 46, give further examination to the prepared abstracts, checking them over before publication. A special feature of "Chemical Abstracts" for many years has been the subject indexes. These are true subject indexes, not indexes of words. The editor gives this work his close personal attention, seeing to it that the indexes are accurate and complete with the entries properly correlated and with superfluous words and entries eliminated. The entry-a-line style, with systematic writing and arrangement of the phrases modifying the subject headings, makes for convenience in use. The author, subject and formula indexes for 1927 contained entries totaling over 150,000.

With the support which has come to this uniquely useful publication, it will be in a position to care for the normal growth of the chemical literature and at the same time expand the abstracts to the most effective average length. Abstracts are to be made more informational and will appear more promptly. It is planned to give industrial chemistry in all its phases increasing attention.

There is a great feeling of satisfaction when an enterprise has been developed to the point where it excels in its specialty. This is true of "Chemical Abstracts." Not only will chemistry and the American Chemical Society benefit directly from the expansion of "Chemical Abstracts," but the many sciences which depend upon it and which contribute but little to its maintenance will also profit. The cost of "Chemical Abstracts" to users is absurdly low; its nearest competitor is offered at several times its subscription price. The support received, therefore, not only constitutes a sound investment for industry but enables industry in a very practical manner and at relatively small cost to encourage science in general and benefit a great number. It only remains to complete the capital sum required to place "Chemical Abstracts" permanently on the sound foundation its service warrants.—*Industrial and Engineering Chemistry.*

## SPECIAL ARTICLES

### HEATING EFFECTS OBSERVED IN A HIGH FREQUENCY STATIC FIELD

DURING developmental research on a short-wave radio transmitter, certain striking heating effects in the vicinity of the antenna have been noted. A preliminary study has brought out several points of interest in regard to their magnitude and characteristics.

During operation of a twenty-kilowatt apparatus discharging from a six-foot rod to ground with 60,000,000 alternations per second of 15,000 volts, the mouth temperature of one bystander rose 2.2° F. in fifteen minutes, while several other individuals exhibited a somewhat smaller rise of temperature.

Studies made with a smaller, 750 watt set, arranged to give rapid alternations of 3,000 volts difference of potential between two parallel metal plates, indicate that there is a well-defined relation between the rate of heating of solutions of different salt content and the frequency of voltage alternation. Thus, at a frequency of 25,000,000 cycles, a sodium chloride solution of 0.05 per cent. concentration has the fastest

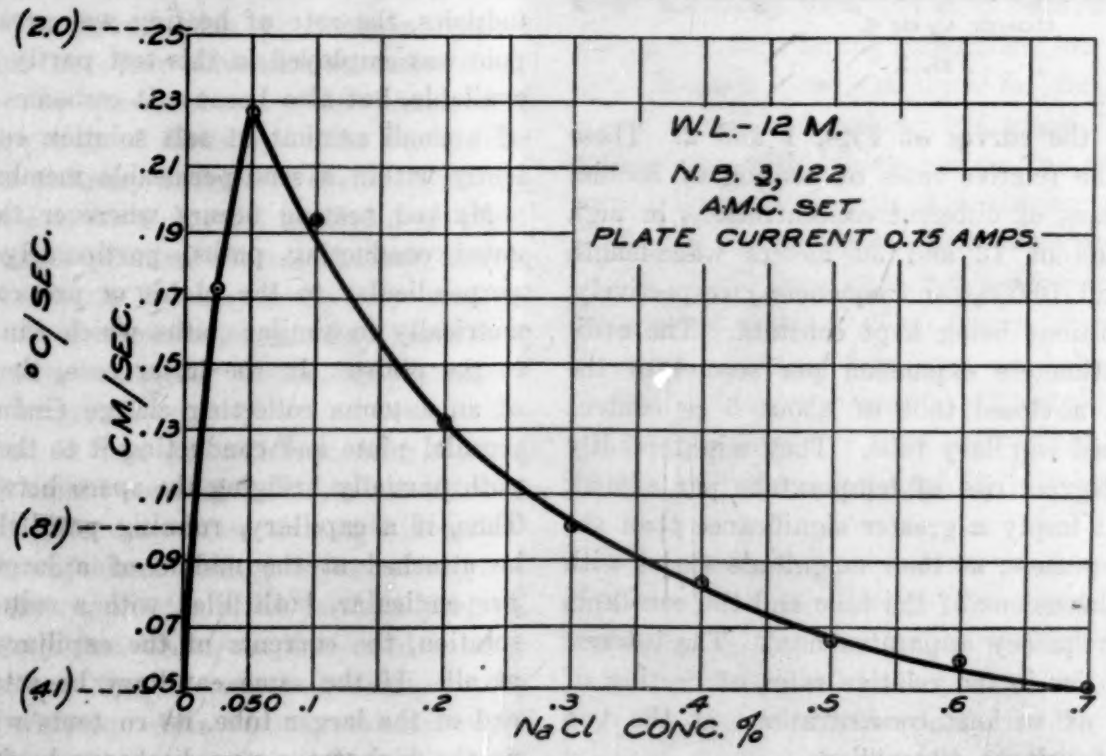


FIG. 1

rate of heating. At a frequency of 10,000,000 cycles a 0.025 per cent., solution heats fastest. The rate of heating in each case falls off abruptly with diminishing concentrations and more gradually with increasing concentrations of the dissolved salt. This is

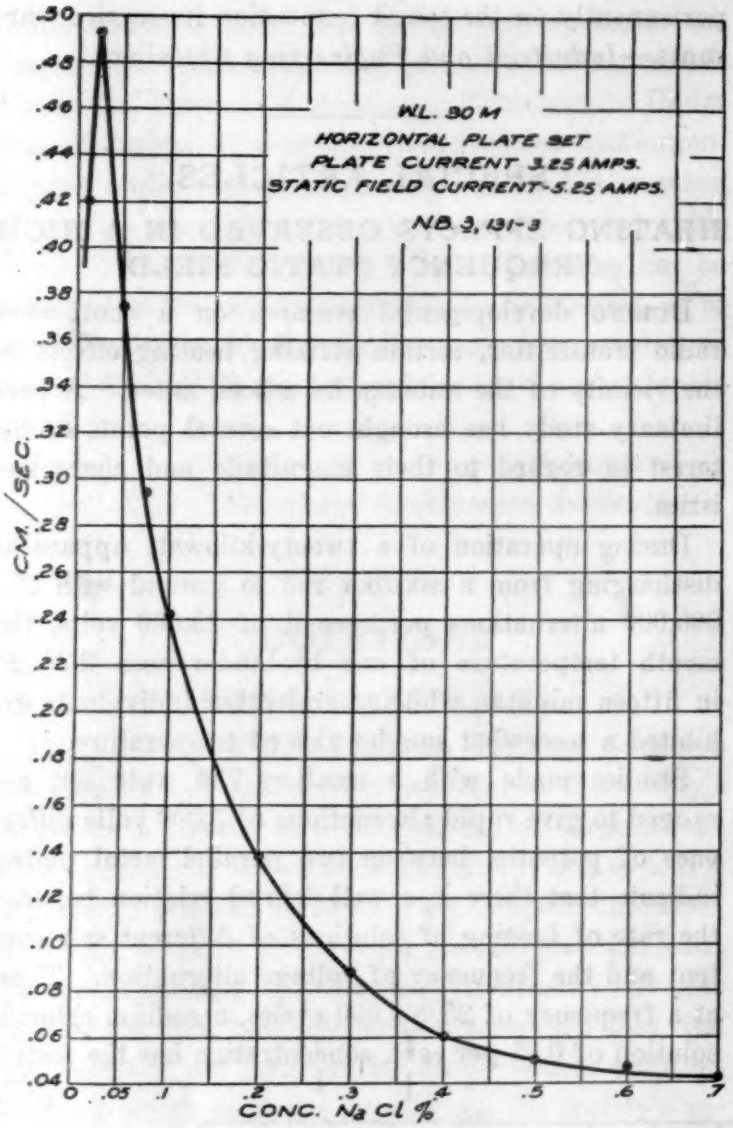


FIG. 2

illustrated by the curves of Figs. 1 and 2. These curves show the relative rates of heating of sodium chloride solutions of different concentrations in high frequency fields of 12 and 30 meters wave-length (25,000,000 and 10,000,000 frequencies) respectively, all other conditions being kept constant. The ordinates are centimeters expansion per second of the solution from a closed tube of about 6 cc content into an attached capillary tube. They might readily be given as degrees rise of temperature per second, but this might imply a greater significance than the figures really possess, as their magnitude varies with the relative dimensions of the tube and the constants of the high frequency apparatus used. The interest of the curves lies in the relative rates of heating of the solutions of various concentrations at the two frequencies of voltage alternation.

Solutions of different salts, but of the same electrical conductivity, heat alike. The rate of heating is apparently proportional to the product $C^2R$ for the conducting path introduced between the plates, the value of R for maximum heating varying with the frequency. For any given solution or other body of suitable conductivity the rate of heating is directly proportional to the length of conducting path measured perpendicular to the plates and inversely proportional to its area of cross-section. Hence the rate of heating of solutions is very much modified by the shape and dimensions of the containing vessel. Thus, in two tubes—B and C—of the same length (measured perpendicular to the plates), but containing, respectively, 22 and 6 cc of salt solution, the former heated 1° C. in 2.3 seconds and the latter in 0.8 second in a field where the capacity was sufficient to heat two tubes of size B as rapidly as one.

The heating effect is, in all these cases, developed within the conducting solution itself. The plates remain cold at all times and are separated by an air gap from the introduced containers and other objects under study. Contact with the plates will produce arcs several inches long and burning and charring of inflammable materials which touch them.

Conducting bodies suspended in a non-heating fluid will generate heat and raise the temperature of the whole mixture. For instance, a T tube containing four cc of distilled water alone did not heat perceptibly in two minutes. One tadpole (1.5 cm long) was introduced, after careful washing with distilled water, and the temperature rose 1.6° C. in 31 seconds while the tadpole was alive and 6.6° C. in 2 minutes after it was dead. In the presence of more tadpoles, the rate of heating was greater. The tadpole was employed in this test partly because it was available, but also because it embodies the conditions of a small amount of salt solution enclosed conveniently within a semi-permeable membrane.

Marked heating occurs wherever there are attenuated conducting paths, particularly if these run perpendicular to the plates or are connected asymmetrically to similar paths which run perpendicular to the plates. In the latter case, the action is that of an antenna collecting charge (induced) from the parallel plate and conducting it to the perpendicular path partially bridging the space between the plates. Thus, if a capillary, running parallel to the plates, be attached at the middle of a larger tube placed perpendicular, both filled with a suitable conducting solution, the contents of the capillary will not heat at all. If the same capillary be attached near the end of the larger tube, its contents will boil as soon as the high frequency discharge begins.

In rats killed after sublethal treatments the only evidence of tissue damage yet observed has been in the outer layers of the muscle cells of the heart immediately adjacent to the pericardial cavity and at the tips of the liver lobes. Such treatments have been shown to raise the temperature of the region exposed, in this case the lower thorax, to 115° F. in three minutes without affecting the rectal temperature. This would indicate that the site of greatest heat development is not in the blood stream nor in the more vascular tissues.

For animals destined for survival, the simplest method for raising the general body temperature rapidly by high frequency is to expose the torso alone between narrow plates, allowing the head and extremities to project outside the field on either side. When the whole body is exposed to a field of sufficient strength to raise the rectal temperature at the rate of about a degree per minute there occurs overheating, blistering and stiffening of the ears and of the leg muscles unless they are adequately shielded. Methods of shielding are being studied and will be presented in a later publication.

An animal whose extremities have been thus overheated while under an anesthetic exhibits upon return of consciousness a most remarkable absence of symptoms, aside from the loss of use of the muscles actually affected. There is no evidence of local tenderness nor of any other discomfort up to the time when breaking away of the killed skin exposes adjacent tissues to outside infection.

These preliminary experiments reveal a field of the utmost interest to the experimental physiologist. Here is a method for producing at will any degree of fever without the introduction of bacteria, toxins, foreign proteins or other adventitious material or condition into the animal body. The increase of temperature is produced directly within the animal structures as in ordinary fever. It occurs promptly while the animal is in a normal condition in other respects. Its uncomplicated effects are thus thrown open to direct study. We may hope very soon to solve the long-vexed question of whether fever is a functional response or merely a condition secondary to infection or trauma.

It may be well in this connection to offer a word of warning. It would seem advisable to use extreme care and to postpone until after thorough investigation the exposure of human beings to the more powerful types of this apparatus. We can not yet predict with certainty just where extreme local heating might occur before the general body temperature gave sufficient warning. The serous cavities would seem to offer the optimum conditions for such local heating, endangering the adjacent tissues.

These general observations are presented at this time for the assistance of any who may be initiating research with such apparatus. Work is being continued in these laboratories, bearing particularly upon the characteristic heating effects produced by high frequency fields both in animal structures and in simpler systems and their modifying reactions upon physiological function and bacteriological and pathological growth.

Grateful acknowledgment is made for the constant encouragement and assistance received from Dr. W. R. Whitney, of the Research Laboratory of the General Electric Company, at Schenectady, as well as for the loan of the necessary apparatus and for its modification from time to time to suit the needs of the work.

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## SEX STERILITY AND THE DIMINUTIVE COPULATORY ORGAN IN THE DOMESTIC FOWL

STERILITY associated with the absence of the male copulatory organ in the domestic fowl has been noted according to the following observations:

While making anatomical examinations of the cloaca of White Leghorns for the presence of the diminutive copulatory organ, four yearling cockerels out of seventy-eight were found in which the organ was absent. Three have proven sterile or sexually abnormal.

One of the four had been killed. During the autopsy the testes were found to be abnormally small, as in a non-functioning state, being one fourth normal size. Records were examined for fertility tests and a second cockerel lacking the organ had been in a mating pen with twelve pullets for two weeks during January, 1928, without fertilizing a single egg.

The two remaining cockerels have now been tested. One fertilized three out of thirty-seven eggs, thirteen days after mating. The fourth fertilized twenty-three out of twenty-four eggs set, being the only one of the four to prove normal. Thirty-three of the remaining seventy-four have been tested, and all showing the organ have fertilized 65 to 98 per cent. of eggs set.

The capons examined (four in number) lack the copulatory organ. Unlike the capon, however, the cockerels lacking the gland retained the characters generally considered as secondary sexual. They appeared as vigorous as any other healthy cockerel. In view of these facts the indications are strong that at least one type of sterility may be detected in the

cockerel by cloacal examination before he is placed in the mating pen. The only sterile birds in the flock—except one that died before this examination was made—were those in which the gland could not be found. Failure to find the gland in a young chick does not always indicate its absence, but in a grown cockerel the gland usually attains a size of two to three mm in diameter. There is considerable variability in size, but no relationship between the size and fertility was noted. These birds are being retained for further study.

Masui[1] claims to be able to separate the sexes of baby chicks by a similar examination—but gives no figures on the degree of accuracy or the possibility of exceptions. From our own observations the sexes can be separated with an accuracy of 75.6 per cent. at two weeks (127), and 81.7 per cent. at four weeks (186), and 88.1 per cent. at five weeks (67). The errors are of two kinds. One is due to faulty observation and is gradually eliminated with practice and familiarity with the technique required. The other error is due to the actual presence of the gland in the female and the absence of the gland in the male. The gland is definitely present in a few female chicks now ten weeks of age, and likewise absent in a few males.

These latter exceptions in chicks may merely represent the delayed dominant action of the gonads over the primary sexual characters of the opposite sex. On the other hand, these exceptions may have a relation to later sexual development and form the interesting class of delayed sexual maturity or even sterility as shown in the adult males examined.

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

### THE POMONA COLLEGE MEETING OF THE PACIFIC DIVISION

THE Pacific Division of the American Association, with the Southwestern Division and a number of participating societies, held its twelfth annual meeting at Pomona College, Claremont, California, Wednesday to Saturday, June 13 to 16, 1928. About five hundred persons were present. The general sessions began on Wednesday with a luncheon at which the progress of research on the Pacific coast during the past year was traced by the speakers. Dr. R. G. Aitken, of Lick Observatory, spoke of discoveries in astronomy; Dr. I. S. Bowen, of the California Institute, in physics; Dr. W. C. Bray, of the University of California, in chemistry; Dr. P. A. Munz, of Pomona College, in botany; Dr. B. M. Allen, of the University of California at Los Angeles, in zoology; and Dr. K. F. Meyer, of the Hooper Foundation, San Francisco, summarized recent research in medical science.

On Wednesday afternoon the remarkable motion picture showing activities of living tissues *in vitro*, prepared by Dr. Ronald G. Canti, of the Cancer Institute and St. Bartholomew's Hospital, London, was shown. The periosteum of chick embryos, an amoeba and a sarcoma of the rat were seen with varying magnifications and varying rates of "speeding up." The behavior of blepharoplasts and other types of cells, the growth of tissues, cell-division and immobilization upon exposure to radium were all very clearly evident. The film was demonstrated by Dr. C. A. Kofoid, president of the Pacific division, who had seen it in Europe and obtained it for the meeting. So many wished to see the film a second time that it was repeated on Friday morning.

In the evening Dr. Frank P. Brackett extended to the visitors a welcome to Pomona College. After a brief response by Dr. E. G. Martin, chairman of the executive committee of the division, Dr. Kofoid gave the presidential address, on "The Luminescence of the Sea." The many unsolved problems involved in the astonishing increase in numbers of particular species of dinoflagellates, the resulting brown or red coloration of the sea-water and its luminous appearance at night, and the destructive effects of these epidemics upon the animals of the sea were touched upon. An outdoor reception followed the address.

The addresses of general interest presented as part of the intersectional meeting of the American Chemical Society will be mentioned in a later part of this report.

The Thursday evening address by Dr. F. H. Seares, assistant director of the Mount Wilson Observatory, was on the subject "Counting the Stars." Dr. Seares showed the manner of exploring the universe by systematic sampling of the numbers of stars of different magnitudes in unit areas of sky at varying angular distances from the Milky Way and of the statistic analysis of the data thus obtained.

On Friday evening Dr. Charles K. Edmunds, the new president of Pomona College, addressed the division on "Some Physical Features of China." His

[1] Masui, K., 1927, Report of the Proceedings of the World's Poultry Congress, Ottawa, p. 156.

observations there were made in connection with the magnetic survey of Mongolia, China, Indo-China and Siam, undertaken by the Carnegie Institution.

On Friday afternoon and Saturday many of the visitors went upon the well-planned excursions. About forty visited Mount Wilson, some arriving at the observatory in the afternoon, others in the evening, others on Saturday. About 120 visited the Huntington Library and its beautifully planted grounds at San Marino just south of Pasadena. About fifteen took part in the Big Pines excursion to the Los Angeles County Park in the mountains northeast of Claremont. The botanists of the party remarked upon the unusually good showing of late spring flowers. Another group made an excursion from Claremont to the coast, following it as far as Dana's Point. The route included the San Juan Capistrano Mission and the Santa Ana Canyon. Others visited the Citrus Experiment Station at Riverside.

The success of the meeting was in very large measure due to the careful preparations made by the Pomona College committee on arrangements, of which Dr. Frank P. Brackett, professor of astronomy, was chairman. The campus and buildings provided a setting which was very comfortable and pleasant, as well as thoroughly adequate for the requirements of the sessions.

At a general business session of the division held on June 14, three vacancies in the executive committee due to expiration of terms were filled by the election of Dr. S. J. Barnett, of the University of California at Los Angeles, Dr. Roy E. Clausen, of the University of California, and Dr. J. H. Moore, of the Lick Observatory. At the meeting of the affiliation committee which followed, several important matters of business were accomplished, including the admission to affiliation of the Oregon, Northwest Utah and Sacramento sections of the Chemical Society. At the meeting of the executive committee on June 15, Dr. Walter S. Adams, of Mount Wilson Observatory, was unanimously elected president of the division for the year 1928–29. It was decided that the 1929 meeting be held at the University of California, probably between May 15 and June 15. A Pacific Division prize of one hundred dollars was established, to be awarded for the most important scientific contribution reported by a member of the division at its next annual meeting.

## AMERICAN PHYSICAL SOCIETY

*(Report by S. J. Barnett, Acting Secretary for the Pacific Coast)*

Two sessions were held on Friday, June 15. The first was a joint session with the Astronomical Society of the Pacific. Attendance at each was between seventy and eighty. Professor Hitchcock, of Pomona College, presided. There were thirty-nine papers presented, and, in addition, eleven other papers were read by title. The papers contributed to the morning session by the Astronomical Society will be referred to in the report for that organization.

It was decided that the next Pacific coast meeting of the Physical Society is to be held at Pasadena on December 8, 1928.

## AMERICAN CHEMICAL SOCIETY PACIFIC INTERSECTIONAL MEETING

*(Report by T. F. Buehrer, Secretary for the Intersectional Meeting)*

An unusually large representation of chemists met this year with the Pacific division. The registration was nearly a hundred. The Arizona, California, Northwest Utah, Oregon, Puget Sound, Sacramento and Southern California sections of the Chemical Society took part jointly in this Pacific Intersectional Meeting. Dr. J. E. Bell was chairman of the unified program committee, and Dr. C. J. Robinson chairman of the committee on arrangements. The program included four sessions for addresses of general interest, which were attended by scientists in other fields as well as by chemists; and there were the usual divisional sessions, in three groups: divisions of analytical and physical and inorganic chemistry; divisions of agricultural, biological and organic chemistry; and the division of chemical education. There was also (on Wednesday afternoon, June 13) a reception given by Pomona College to the chemists, and on Thursday evening a dinner in the Guildhall, attended by about seventy chemists, followed by a brief motion picture, "The Rubber Latex," with explanatory lecture by Dr. C. R. Park. There was a luncheon on Friday for the Chemical Education Senate and a dinner for teachers of chemistry.

The first of the general addresses mentioned was given Thursday morning by Dr. Linus Pauling, of the California Institute, on "The Nature of the Chemical Bond." He showed that with the application of the quantum mechanics to chemical reaction, the two principal factors which are responsible for chemical valence are the Heisenberg-Dirac resonance phenomenon and the Pauli Exclusion Principle.

As illustrations he chose the hydrogen molecule and the hydrogen molecule-ion and stated that the foregoing principles verify G. N. Lewis' theory of the shared electron bond, which had been deduced from purely chemical evidence.

Professor W. C. Bray, in the first address of the second session, on "Catalysis and Chemical Reaction," outlined the general method of determining the mechanism of a reaction from rate measurements, choosing as an illustration the catalytic decomposition of hydrogen peroxide in a bromine-bromide solution. The constants calculated from the integrated rate expressions were shown to establish the hypobromous acid mechanism in this decomposition. He stated that as our knowledge of mechanism increases, it will be possible to predict with certainty a specific catalyst for any given reaction. Professor E. C. Franklin, speaking on "Liquid Ammonia as a Solvent," showed some striking experiments to emphasize the analogy between reactions in liquid ammonia and the corresponding reactions in the water system. Professor J. H. Hildebrand, in his address on "Developments in the Theories of Solutions," outlined the principal features of his "Internal Pressure Theory of Solubility" and presented a new equation for expressing the deviations from Raoult's law of "regular" solutions. This equation, derived thermodynamically, makes it possible to calculate solubilities of solids in certain solvents if the critical solution temperatures are known.

The last of the general sessions was a lecture on "Thyroxine and the Thyroid Gland," by Dr. George Barger, of the University of Edinburgh. Dr. Barger pointed out the theoretical problems and the experimental difficulties successively arising in the synthesis of thyroxine and how the research ultimately resulted in a successful commercial method of manufacture. He stated that the synthetic product was found by experiment to be absolutely identical in its physiological effects with the natural product.

There were twenty-six papers given before the divisions of analytical and physical and inorganic chemistry, fifteen before the divisions of agricultural, biological and organic chemistry and five before the division of chemical education.

At the business session of the Intersectional Meeting of the Chemical Society, it was decided to continue the plan of holding an intersectional meeting annually in conjunction with the Pacific Division of the American Association, and a program committee for the 1929 meeting was elected.

## AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS—PACIFIC SLOPE BRANCH

*(Report by Roy E. Campbell, Secretary)*

Four sessions for presentation of entomological papers were held, with an attendance of 115 persons. In the first session, devoted to fruit insects, Perez Simmons and W. D. Reed showed that infestation of dried figs in California is chiefly due to the dried-fruit beetle. Trapping of overwintering adult beetles is recommended. Harry S. Smith and Harold Compere found the native home of the Citrophilus mealy-bug to be in Australia. Some new natural enemies of the mealy-bug have been brought to California. O. H. Swezey's paper on insect pests in Hawaii, most of which were introduced from other countries, reported success in the discovery, importation and utilization of their natural enemies. W. W. Jones gave data on the biology of a new species of Nepticula infesting the holly-leaved cherry. W. B. Parker reported a change in the habits of the pear-leaf blister mite, which has now become a bud mite.

The Thursday afternoon session, on evaluating results of field experiments in insect control, was begun by Ralph H. Smith. He pointed out the great variability in distribution of an insect (*e.g.*, the codling moth) in a field or orchard. This variability must be taken into account. J. R. LaFollette and R. S. Woglum described the twig unit system of determining results of treatment for black scale. H. J. Ryan told of a large-scale project of combating the Argentine ant over a thirty-thousand-acre district of citrus trees. Control of the Hippelates fly in the Coachella valley was reported by W. B. Herms. Although its breeding-places can not yet be found, the use of a special trap is proving helpful. S. F. Light, in a paper on the termites of the Pacific Coast, gave facts as to the different species, their distribution and economic importance. In the discussion, E. M. Ehrhorn stated that subterranean termites in Hawaii are controlled by fumigating the nests with carbon bisulphide. Injection of Paris green into tunnels of other forms gives promise of success.

The Friday morning session began with a very definite account by E. R. de Ong of specifications for oils used in spray work. R. S. Woglum's paper on climatic influence in distribution of citrus insects distinguished a group or assemblage of species which is seriously harmful only in the coastal areas of equable temperature, an interior group harmful in the hotter districts and a wide-spread group which is however checked in the interior by a few days of very hot weather. A. M. Boyce reported a progressive development of resistance to hydrocyanic acid gas in Drosophila and in aphids. R. W. Doane, in a study of a light epidemic of poliomyelitis, could find no evidence that it was spread by insects. W. H. Thorpe's paper on biological races of Hyponomeuta showed that there are biological differences among individuals reared on different plants, although no

differences in appearance may be perceptible, since they develop well only on their original host-plants. W. B. Herms reported a markedly favorable effect of yeast upon development of the mosquito, *Theobaldia incidens*.

Two papers were scheduled for Friday afternoon. The first, by W. B. Herms, showed the effect of quantity of larval food upon size of adult and upon the sex ratio in the greenbottle fly and in Theobaldia. The final address was by E. O. Essig, on the development of entomology in California. It included such items of interest as that, although the Spaniards introduced certain insects into California, no collection or description of insect species was done until the advent of the Russians.

The entomologists joined the other biologists present in a dinner on Thursday evening. Officers elected for the coming year are O. H. Swezey, *chairman;* S. B. Freeborn, *vice-chairman;* Roy E. Campbell, *secretary-treasurer*.

### Western Society of Naturalists

*(Report by Charles V. Taylor, Secretary)*

The opening session, on Thursday morning, June 14, was devoted to an invitation program. Dr. T. Wayland Vaughan, director of the Scripps Institution, spoke of oceanographic research in the Pacific. Dr. C. W. Metz gave an account of his recent studies on individuality of chromosomes. Dr. T. H. Goodspeed described some effects of radiation on sex cells and on the vegetative organs of plants. Dr. E. G. Martin summarized his recent studies upon the recovery process following muscular exercise.

The afternoon was given to a joint session with the Ecological Society of America. There were in all fifteen papers presented.

The Western Society of Naturalists took part in the dinner for all biologists on Thursday evening at the Guildhall.

There were fourteen papers presented during the Friday morning session.

### Ecological Society of America

*(Report by A. G. Vestal, Secretary for the Pomona College Meeting)*

An afternoon session with the Western Society of Naturalists was held Thursday, June 14. The Friday morning session of the Ecological Society began with a geographical paper by Richard J. Russell, of the Texas Technological College, on the land-forms resulting from the peculiar physiographic processes in the tundra climate of high mountain areas in the western United States. W. E. Allen discussed the futility, for certain environmental problems, of attempts to assign a dominating rôle to one "limiting factor." The emphasis should rather be placed on the relative significance of a number of variable factors. A paper by E. C. O'Roke described an apparently new disease of the California quail, which is killing the birds in great numbers. Ebbe C. Hoff enumerated the parasites found on sticklebacks. Some of them cause an easily recognized change in the external appearance of the fish. Hebbel E. Hoff described a number of marine ciliates grown in cultures from collections made in Puget Sound. Albert W. Snoke told of the advantages of the micro-Winkler apparatus of Thompson and Miller for making determinations of dissolved oxygen. He also reported work by R. C. Miller and A. W. Snoke on successions of hay-infusion organisms in cultures, and on the accompanying changes in carbon-dioxide content and hydrogen-ion concentration. Robert C. Miller reported on determinations made by Thomas G. Thompson and himself of contrasts in temperature, salinity, oxygen-content and other conditions of the sea-water at the margins of two opposing tidal currents.

### Society for Experimental Biology and Medicine—Pacific Coast Branch

*(Report by E. G. Martin, Secretary for the Pomona College Meeting)*

One session was held on the afternoon of June 14. About fifty persons were in attendance. In accordance with the custom of the society no time-limit was set for the presentation or discussion of papers. Eleven papers were presented by their authors. In addition three papers were read by title.

### American Phytopathological Society—Pacific Division

*(Report by B. A. Rudolph, Secretary)*

Three sessions for reading of papers on plant disease were held. At the business session which preceded the papers of Thursday morning, J. W. Hotson was elected president for the succeeding biennium, E. Carsner, vice-president, B. A. Rudolph, secretary-treasurer, and J. T. Barrett, councilor.

The first paper, on "Rusts of the Pacific Northwest," was by J. W. Hotson. The elaborate key is based primarily upon host-plants. Mr. Hotson reported also on the destructive occurrence of *Armillaria mellea* in the timbers of mines and wells in Washington. A. M. Boyce and H. S. Fawcett described the attacks of an Aspergillus upon mealybugs in southern California insectaries. Humid conditions

favor the attacks. Artificial inoculation is usually followed by death within forty-eight hours. L. J. Klotz pointed out that the inhibition of enzyme action may be a factor in the resistance of plants to disease. Experiments with powdered bark of citrus plants resistant to Phytophthora indicate inhibition of the diastatic action of the fungus. H. E. Thomas showed that mechanical pressure, rather than enzyme action, seems to be the main factor in the penetration of healthy root tissue of host trees by *Armillaria mellea*.

The Thursday afternoon program began with an account of W. W. Mackie's long-continued experiments on inheritance of resistance to blast in oats. They show a 1:2:1 ratio for segregation of resistant and susceptible strains, indicating a single factor for blast resistance. J. T. Barrett showed that a crown-rot of black walnut used as a root stock for the Persian varieties is due to *Phytophthora cactorum* and found great difference in the susceptibility of different stocks. In a study of inorganic nutrition of the fungi, A. R. Davis, R. H. Marloth and C. J. Bishop found that culture-medium salts devoid of calcium and boron retarded both growth and spore-formation of certain molds. Both Ca and B are regarded as essential plant foods. G. Savastano and H. S. Fawcett showed that certain mixed inoculations produced characteristic rots in citrus fruits and that the rate of decay may depend upon the mixture of organisms used. I. C. Jagger reported on the brown blight disease of lettuce. The cause has not yet been determined, but the infection now appears to come from the soil. The constant occurrence of Asterocystis radicis on roots of affected plants has led to experiments upon this fungus. O. A. Plunkett prescribed control for *Peronospora sparsa*, which affects hothouse roses in Southern California.

In the Friday morning session, T. C. Scheffer described results of steam sterilization of soil of seedbeds for conifers by the inverted pan method. Good control of damping-off fungi was obtained. Keith O'Leary reported a new moss host, a Leucolepias, for *Eocronartium muscicola*, in a new locality in Washington. The experiments of M. Shapovalov and F. S. Beecher on tomato yellows showed the following effects when the light intensity was reduced: prolongation of incubation period in the host, acceleration of plant growth, mildness of disease symptoms and reduced incidence of the disease. J. G. Brown showed that Pima cotton grown in soils containing 0.2 to 0.4 per cent. NaCl shows improved resistance to angular leaf-spot caused by Phytomonas, due to collection of Cl ions in the parenchyma. F. Sidney Beecher's measurements of light intensity by means of Dr. R. F. Bacon's chemical photometer, using uranyl acetate and oxalic acid, enabled him to estimate the amount of light cut off by glass, muslin and other plant-house coverings and to determine that the artificial illuminants now used are very inadequate as compared with sunlight. He suggests that a much wider range of the spectrum than the violet and ultra-violet portions may be photochemically effective. Clayton O. Smith, in cross-inoculation and cultural studies of citrus blast and allied organisms, finds great similarity of *Bacterium citriputeale*, *B. syringae* and *B. cerasus*. Further studies are in progress. E. Carsner and C. F. Lackey report, among other results, an attenuation of curly-top virus by passing it through resistant sugar beets or through *Chenopodium murale*. In a study of Texas root-rot, R. B. Streets found that the fungus, *Phymatotrichum omnivorum*, attacks the cortex of tap-roots of cotton and alfalfa. Chemical sterilization of the soil is successful, but thus far too costly.

The western members of the American Meteorological Society met again this year with the Pacific Division of the American Association for the Advancement of Science. They had done so previously at the Los Angeles meeting in 1923. There were three sessions for presentation of papers.

The Astronomical Society of the Pacific held two sessions on Thursday, June 14, at which seventeen papers were presented. To the joint session on Friday morning with the Physical Society, the astronomers contributed six papers, mostly on stellar spectra. Closely allied studies were reported by the physicists, on spark spectra and related subjects.

The newly organized Pacific Section of the Botanical Society of America, covering the entire field of botany, held its first meeting with the other societies at Pomona College. It replaces the western division of the Physiological Section of the Botanical Society. It held three sessions for the reading of botanical papers.

The Western Society of Soil Science met on Tuesday, June 13, 1928 (the day preceding the meeting at Pomona College), at the Citrus Experiment Station, Riverside. This arrangement permitted the members to inspect the laboratories and field experiments of the station, and afterward to attend the meeting of the Pacific Division only a few miles away at Claremont. Their program included the presentation of twenty papers.

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